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Applicants	: **Yoshiaki SUZUKI,et al.**	)
Application No.	: **10/606237**	) TRANSLATION OF PRIORITY DOCUMENTS AND DECLARATION IN SUPPORT THEREOF
Filed	: **June 26, 2002**	)
For	: **LIQUID TRANSFER DEVICE, LIQUID TRANSFER METHOD AND LIQUID REMAINING AMOUNT MONITORING METHOD OF LIQUID TRANSFER DEVICE**	)

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

I, Atsuko SEKIGUCHI, of Tani & Abe Patent Office, No. 6-20, Akasaka 2-chome, Minato-ku, Tokyo 107-0052, Japan, declare that:

1. I know well both the Japanese and English languages.

2. I translated Japanese Patent Application No.2002-188789 of June 27, 2002 from the Japanese language to the English language, a copy of the translation being attached hereto.

3. The attached English translation of the Japanese application identified in paragraph 2 above is a true and correct translation to the best of my knowledge and belief.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed this 9th day of January, 2007

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A LIQUID TRANSFER DEVICE AND A LIQUID TRANSFER METHOD

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[TITLE OF THE INVENTION] A LIQUID TRANSFER DEVICE AND A LIQUID TRANSFER METHOD

[SCOPE OF CLAIM FOR A PATENT]

[Claim 1]

A liquid transfer device transferring liquid for enhancing durability of an image on a printed surface of a printed product printed with ink, comprising:

a liquid transfer member having a transfer surface contacting the printed surface of said printed product and transferring the liquid on the printed surface of said printed product,

said liquid transfer member including

a liquid accumulating portion accumulating the liquid; and

a restricting portion which is formed from a porous film formed with fine pores or said transfer surface per se and supplies the liquid in said liquid accumulating portion to said transfer surface with restriction.

[Claim 2]

A liquid transfer device transferring liquid for enhancing durability of an image on a printed surface of a printed product printed with ink, comprising:

a liquid transfer member having a transfer surface contacting the printed surface of said printed product and transferring the liquid on the printed

surface of said printed product; and

a holding member for holding said liquid transfer member,

said liquid transfer member including

a liquid accumulating portion accumulating the liquid; and

a restricting portion which is formed from a porous film formed with fine pores or said transfer surface per se and supplies the liquid in said liquid accumulating portion to said transfer surface with restriction.

[Claim 3]

The liquid transfer device as claimed in claim 1, wherein said liquid accumulating portion is formed from a sheet form member having uniform density.

[Claim 4]

The liquid transfer device as claimed in claim 1, wherein said liquid accumulating portion is formed from a sheet form member having different density in thickness direction thereof.

[Claim 5]

The liquid transfer device as claimed in any one of claims 1 to 4, wherein said liquid accumulating portion is formed from a sheet form member provided with treatment for continuously varying a density in thickness direction with a predetermined gradient.

[Claim 6]

The liquid transfer device as claimed in any one of claims 1 to 5, wherein said liquid accumulating portion is formed by laminating a plurality of sheet form members having different densities.

[Claim 7]

The liquid transfer device as claimed in any one of claims 2 to 6, wherein capillary forces of said liquid accumulating portion, said porous film and the printed surface of said printed product are set for establishing a relationship:

liquid accumulating portion < porous film < printed surface of printed product.

[Claim 8]

The liquid transfer device as claimed in claim 6, wherein densities of respective sheet form members forming said liquid accumulating portion are set for producing greater capillary force at closer position to said transfer surface.

[Claim 9]

The liquid transfer device as claimed in any one of claims 6 to 8, wherein said liquid accumulating portion is formed with a first layer and a second layer having different densities, said first layer is located at a position more distant from said transfer surface than said second layer, and said first layer has greater density than said second layer.

[Claim 10]

The liquid transfer device as claimed in any one of claims 6 to 9, wherein said first layer and said second layer are formed from a fibrous body or a foamed sponge body, a density of said first layer is in a range of 0.05 to 0.5 g/cc, and a density of said second layer is in a range of 0.01 to 0.2 g/cc.

[Claim 11]

The liquid transfer device as claimed in any one of claims 1 to 8, wherein each of said sheet form members forming said liquid accumulating portion is formed from a PTFE film and a PET film.

[Claim 12]

The liquid transfer device as claimed in claim 1, wherein said porous film has a thickness of 10 to 200 μm, and a diameter of fine pore is 0.1 to 0.5 μm.

[Claim 13]

The liquid transfer device as claimed in any one of claims 1 to 12, wherein said liquid transfer member has a normally flat transfer surface, when the printed product is mounted and urged onto said transfer surface, said liquid accumulating portion is elastically deformed corresponding to a curved shape of the printed surface of said printed product so that said curved printed surface and said transfer surface are contacted over entire area.

[Claim 14]

The liquid transfer device as claimed in claim

13, wherein stripe form grooves are formed on a bottom surface of said liquid accumulating portion.

[Claim 15]

A liquid transfer method for transferring liquid enhancing durability of an image to a printed surface of a printed product printed with ink, comprising the steps of:

providing a liquid accumulating portion accumulating the liquid, and a restricting portion which is formed from a porous film formed with fine pores or said transfer surface per se and restrictively supplies the liquid in said liquid accumulating portion to a transfer surface contacting the printed surface of said printed product; and

transferring the liquid supplied through said restricting portion by mounting the printed surface of said printed product on said transfer surface in contact therewith.

[Claim 16]

The liquid transfer method as claimed in claim 15, wherein said printed surface of said printed product has an area greater than said transfer surface, and said printed surface is contacted with said transfer surface dividedly for a plurality of times.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field to Which the Invention Pertains]

The present invention relates to a liquid transfer device and a liquid transfer method for transferring or applying a liquid to a printing surface of a printing medium printed by an ink-jet printing apparatus.

[0002]

[Prior Art]

An ink-jet printing apparatus has been used for not only printing texts of characters or the like on paper but also photographically printing associating with the recent progress of technical development in down-sizing a droplet and increasing tone levels. At the same time, the application field of an ink-jet printing apparatus has further extended together with spreading of digital cameras since an output of not only a text or a design but also a photographic printed product or graphic art can be performed, like a display. As a consequence, there have arisen problems how to keep an image on a printed product and to prolong a lifetime of the image. A printed product printed by depositing dye-type ink on an appropriate medium (printing medium) has good color developing ability, but is lower in durability and keeping the image. On the other hand, a printed product printed by pigment-type ink is superior in keeping the image but is inferior in color development ability and abrasion-resistance.

[0003]

As a result, in view of keeping the image, a one approach directs to achieve highly durable printing with a pigment. Another approach directs to protect a coloring agent having low durability such as a dye. As the latter approach, it has been known to cover the image with glass, or to laminate a film forming resin, such as acryl type protective film or a sheet, over the image.

[0004]

[Problems to Be Solved by the Invention]

However, in the conventional protection method, such as covering the printed product with glass or laminating resin over the printed product, the image cannot be directly viewed since image texture is significantly sacrificed. In other words, the image is viewed across the film or glass and raw image cannot be viewed directly.

[0005]

On the other hand, Japanese Patent Application Laid-Open No. 9-48180 discloses a treatment for a measure for bleeding of image due to deposition of water droplets on the printed product or degradation of image due to irradiation of ultraviolet ray. Even in such a case, it has been required to achieve durability higher than a practical level for a longer period of time. For example, a liquid transfer device

has been provided in the assumption that an image may not bleed even in contact with water according to a printing medium even in a printed product printed with a dye-based ink, and further, that no degradation occurs on the order of 10 years in durability test with ultraviolet ray.

[0006]

However, even if a printing medium applied with water resistance or light fastness against ultraviolet ray is used when the image is stuck onto a wall or the like, it has been found that the degradation occurs by moisture or minor component gas such as ozone, nitrogen oxide or sulfur oxide contained in the air.

[0007]

It is an object of the present invention to provide a liquid transfer device and a liquid transfer method which can enhance durability of an image with maintaining image texture of a raw image by transferring liquid to a printing medium on which an image is printed without laminating a protective member, such as glass, film or the like, on the image, like in the above-described prior art.

[0008]

[Means for Solving the Problems]

The inventors have researched and developed an apparatus and method which permits directly viewing a raw image without interposing a transparent layer,

such as glass, film or the like on a printing medium, can maintain image texture for a long period and can transfer an appropriate amount of liquid without depositing the liquid on hand.

[0009]

That is to say, according to a first aspect of the present invention, there is provided a liquid transfer device transferring liquid for enhancing durability of an image on a printed surface of a printed product printed with ink, comprising: a liquid transfer member having a transfer surface contacting the printed surface of said printed product and transferring the liquid on the printed surface of said printed product, said liquid transfer member including: a liquid accumulating portion accumulating the liquid; and a restricting portion which is formed from a porous film formed with fine pores or said transfer surface per se and supplies the liquid in said liquid accumulating portion to said transfer surface with restriction.

[0010]

According to a second aspect of the present invention, there is provided a liquid transfer device transferring liquid for enhancing durability of an image on a printed surface of a printed product printed with ink, comprising: a liquid transfer member having a transfer surface contacting the

printed surface of said printed product and transferring the liquid on the printed surface of said printed product; and a holding member for holding said liquid transfer member, said liquid transfer member including: a liquid accumulating portion accumulating the liquid; and a restricting portion which is formed from a porous film formed with fine pores or said transfer surface per se and supplies the liquid in said liquid accumulating portion to said transfer surface with restriction.

[0011]

According to a third aspect of the present invention, there is provided a liquid transfer method for transferring liquid enhancing durability of an image to a printed surface of a printed product printed with ink, comprising the steps of: providing a liquid accumulating portion accumulating the liquid, and a restricting portion which is formed from a porous film formed with fine pores or said transfer surface per se and restrictively supplies the liquid in said liquid accumulating portion to a transfer surface contacting the printed surface of said printed product; and transferring the liquid supplied through said restricting portion by mounting the printed surface of said printed product on said transfer surface in contact therewith.

[0012]

According to the invention with the construction set forth above, it becomes possible to transfer an appropriate amount of liquid just in proportion to a printed product on which an image is printed with ink, so that durability of the image, which has been big problems to be solved in the ink-jet printing apparatus, can be enhanced to be greater than that of silver salt picture without forming an optical film, such as glass, resin and so forth on the printed product. Thus, a digital image of superior image quality can be formed at low cost utilizing a superior function of the ink-jet printing apparatus.

[0013]

As applicable objects, printed products using various sizes of medium (printed medium), such as

- Photograph size called L size (89 mm × 119 mm)
- Post card (100 mm × 148 mm)
- 2L size (double of L side) (119 mm × 178 mm)
- A4 size (210 mm × 297 mm),

may be listed, and an appropriate amount of liquid can be transferred to such various size of printed products.

[0014]

[Modes Carrying Out the Invention]

The present invention will be discussed hereinafter in detail.

[0015]

(Printed Product, Printing Medium and Protecting Liquid)

At first, discussion will be given for a printed product to be used in the present invention and a protecting liquid (simply referred to also as "a liquid") to be transferred to the printed product with reference to Figs. 1 and 2. It should be noted that a word "transfer" used for description of the present invention includes applying a liquid for protection on a surface of a printed product by contacting a printed product subjected to protecting treatment with a liquid transfer member of a liquid transfer device. [0016]

On the other hand, in the present invention, a word "transfer surface" represents either a surface per se of a porous member typified in the following embodiments or a surface of a desired impregnated member. Particularly, the member is an absorbent member of which a liquid impregnating amount is restricted by a restricting member including at least one layer of film, for restricting a transfer amount of liquid between the printed product to be protected and a liquid storage portion, and is an absorbent body, such as thin fibrous body (including paper), sponge or a laminated structural body or the like, which can absorb a necessary amount of liquid for one or more printed product for applying liquid thereon.

The printed product applied to the protecting treatment (subjected to the protecting treatment) according to the present invention is one formed with an image by applying inks containing coloring agents on a printing medium having a porous layer as an ink receptacle layer. Then, in the protecting treatment according to the present invention, a liquid such as silicon oils or fatty acid esters is impregnated in a printed product. Accordingly, it is desirable that the printing medium is those not causing so-called strike through of the liquid. For example, it is preferably a printing medium which performs printing by at least absorbing coloring agents, such as dye, pigment or the like in fine particles forming a porous structure in an ink receptacle layer provided on a support body. The printing medium of such structure is particularly suitable for ink-jet printing.

[0017]

Furthermore, such printing medium for ink-jet printing is preferably a so-called absorbent type which absorbs ink with void formed in the ink receptacle layer on the support body. The ink receptacle layer of absorbent type is primarily formed with fine particle and is formed into porous layer containing binder and/or other additive, as required.

[0018]

As examples of fine particle, one or more kind

selected among silica, clay, talc, calcium carbonate, porcelain clay, aluminum oxide, such as alumina, alumina hydrate or the like, diatom earth, titanium oxide, hydrotalcite, inorganic pigment such as zinc oxide or organic pigment, such as urea formalin resin, ethylene resin, styrene resin or the like, may be used.

[0019]

Preferred binder to be used may be water soluble polymer or latex. For example, polyvinyl alcohol or modification thereof, starch or modification thereof, gelatin or modification thereof, gum Arabic, cellulose derivative, such as carboxymethyl cellulose, hydroxyethyl cellulose, hydroxypropylmethyl cellulose, SBR latex, NBR latex, methyl metacrylate-butadiene copolymer latex, functional group modified polymer latex, vinyl type polymer latex, such as ethylene-vinyl acetate copolymer, polyvinyl pyrrolidone, maleic anhydride and copolymer thereof, acryl ester copolymer may be used. These may be used as combination of two or more kinds as required. In addition, an additive may be used. For example, dispersing agent, thickening agent, pH adjuster, lubricant, fluidized modifying agent, surface active agent, anti-foaming agent, mold lubricant, fluorescent bleach, ultraviolet absorber, oxidant inhibitor and so on may be used.

[0020]

Particularly preferred printing medium is those

formed with the ink receptacle layer primarily consisted of fine particles having average particle size smaller than or equal to 10 μm, and more preferably smaller than or equal to 1 μm. Particularly preferred fine particles are fine particles of silica or aluminum oxide or the like.

[0021]

Preferred fine particles of silica are silica fine particles typified by colloidal silica. While colloidal silica per se is available from a market, particularly preferred is those disclosed in Japanese Patent No. 2803134, Japanese Patent No. 2881847, for example.

[0022]

Preferred fine particles of aluminum oxide may be fine particles of alumina hydrate. One of such alumina type pigment may be alumina hydrate expressed by the following formula:

$$Al_2O_{3-n}(OH)_{2n} \cdot mH_2O \quad \ldots (1)$$

In the above formula, n represents any one of integer of 1, 2 and 3, and m represents a value in a range of 0 to 10, and preferably 0 to 5. However, m and n cannot be 0 simultaneously. In many cases, mH_2O represents even desporptive water phase not to be involved with formation of mH_2O crystal grating. Therefore, m may be a value of integer or non-integer. Also, by heating this kind of material, m can reach

the value of 0. As alumina hydrate, it is typically preferred those produced by hydrolysis of aluminum alcoxide or hydrolysis of sodium aluminate disclosed in U. S. Patent No. 4,242,271 and U. S. Patent No. 4,202,870, or by a method of adding an aqueous solution of sodium sulfate, aluminum chloride or the like to an aqueous solution of sodium aluminate as disclosed in Japanese Patent Application Publication No. 57-44605.

[0023]

It should be noted that a reason of effectiveness that a porous layer made of fine particles of aluminum oxide or silica is applied to particularly protecting liquid, as follow: it has been found that the coloring agent to be absorbed by fine particles of aluminum oxide or silica should cause significant tenebrescence of the coloring agent due to gases of NO_x, SO_x, ozone or the like. However, these particles can draw gases so that such gases may present in the vicinity of the coloring agent to easily cause tenebrescence of the coloring agent.

[0024]

Furthermore, the printing medium for ink-jet printing using fine particles of aluminum oxide or fine particles of silica is superior in affinity, absorbability, fixing ability with protecting liquid, and can attain transparency, luster and fixing ability

of the coloring agent in the printing liquid, such as dye or the like, as required for realizing photograph quality as set forth above. Therefore, such printing medium is optimal for use in the present invention. A mixture ratio of the fine particles and binder of the printing medium is preferably in a range of 1:1 to 100:1 by weight. By determining the amount of the binder in the foregoing amount, an optimal pore volume for impregnating the protecting liquid into the ink receptacle layer can be maintained. A preferred content of fine particles of aluminum oxide or fine particles of silica in the ink receptacle layer is greater than or equal to 50 Wt%, more preferably greater than or equal to 70 Wt%, further preferably greater than or equal to 80 Wt%, and most preferably smaller than or equal to 99 Wt%. A coating amount of the ink receptacle layer is preferably greater than or equal to 10 g/m^2 as converted into dried solid component in order to enhance impregnating ability of image fastness enhancing agent, and most preferably 10 to 30 g/m^2.

[0025]

As the support of the printing medium, there is no particular constraint, and any supports may be used as long as the ink receptacle layer containing the foregoing fine particles can be formed and having sufficient stiffness so as to be fed by a feeding

mechanism of the ink-jet printer or the like. As the support, a sheet of paper provided with appropriate sizing at least on the surface to be formed the ink receptacle layer, one having high density porous layer (so called baryta layer) formed by coating inorganic pigment, such as barium sulfate or the like, and so on, on the fibrous support (such as baryta paper) may be preferably used. When such support is used, if the printed product provided with fastness enhancing treatment is left under high temperature and high humidity environment for a long period, it can quite effectively restrict the surface of the printed product to be sticky for exudation of the fastness enhancing agent, and can achieve storage stability. It should be noted that as a form of the printing medium having the porous layer on the surface, not only one formed with the porous ink receptacle layer on the support set forth above, but also anodized aluminum or the like may be used.

[0026]

The liquid for protecting the printed product used in the present invention may be those not influencing the fixed image not dissolving the coloring agent deposited on the porous layer of the printing medium, being non-volatile, and protecting the coloring agent upon filling void in the porous layer for enhancing durability of the image. On the

other hand, the liquid not adversely influencing for color tone of the image and being transparent and colorless capable of enhancing quality of the image, is superior in general applicability. However, in some occasion, colored liquid may also be used. Also, while the odorless protection liquid is superior in general applicability, it may also be possible to add some perfumery in a range not affecting to the image for discharging aroma matching with the image.

[0027]

As the protecting liquid, for example, at least one selected among fatty acid ester, silicon oil, modified silicon and fluorinated oil may be used. Particularly, for pore distribution and pore size of the printing medium, one dispersed and homogenized is preferred and entirely covering a presenting region (two-dimensional, three-dimensional) of the printed base material.

[0028]

Such protection liquid is held in a transfer tool or a transfer device, which will be discussed later. It is preferred that the liquid has an appropriate permeability into the porous layer, on which the coloring agent of the printed image is fixed. For example, it is preferred that the liquid has viscosity in a range of about 10 to 400 cp (centipoises; 0.01 to 0.4 Pa·s). By using the liquid

having such viscosity, irregularity in small application amount less than or equal to about 1 mm immediately after transfer may be effectively homogenized using malleability by flow of the liquid.

[0029]

Figs. 1(a) to 1(c) show conditions where the protection liquid set forth above is transferred to a printed product. In Figs. 1(a) to 1(c), there are shown a base paper (a support body) M1, a reflection layer M2 and an ink receptacle layer M3. Fig. 1(a) shows a condition before transferring the liquid, Fig. 1(b) shows a condition immediately after transfer of the liquid in which excessively transferred liquid is present on a surface of the printed product and optically recognized, and Fig. 1(c) shows a condition after a lapse of 2 to 5 minutes from the transfer of the liquid in which the excessively transferred liquid is absorbed into the base paper.

[0030]

Figs. 2(a) and 2(b) are sections showing conditions before and after transfer of an appropriate amount of liquid on the printed product PM by the liquid transfer device according to the present invention. For the printed product PM in the condition where the coloring agent CM (dye in the embodiment herewith discussed) penetrates into the ink receptacle layer 3 shown in Fig. 2(a), an appropriate

amount of liquid L is applied as shown in Fig. 2(b). Then, the liquid L is uniformly propagated over the entire ink receptacle layer M3 to certainly hold the coloring agent CM, and the extra amount of liquid may not overflow from the ink receptacle layer to maintain in a condition not perceived even optically.

[0031]

By realizing an appropriate amount of liquid transfer as set forth above, enhancement of an optical density (OD) can be observed and improvement of durability can be found. For the porous layer of the printed product fixed the coloring agent, necessary amount of the protecting liquid for filling void in the porous layer, to which the coloring agent is fixed, or slightly greater amount than the necessary amount is applied. However, if the liquid amount applied to the printed product significantly exceeds the foregoing necessary amount, a layer can be formed on the surface of the printed product by the excess amount of the liquid and whereby to cause degradation of image quality. For this reason, when a large amount of the liquid is applied to the surface of the printing medium, an operation for removing the excess amount of the liquid from the surface of the printed product becomes necessary. However, it is difficult to satisfactorily remove the liquid with maintaining necessary and sufficient light amount. Furthermore,

due to botheration in deposition of the liquid on hand during operation, the operation for liquid removal is significantly troublesome. Furthermore, wasting liquid consuming amount becomes large to cause increasing of running cost.

[0032]

Here, results of transfer of the liquid for the printing medium having the ink receptacle layer having dimension and shape corresponding to one post card, are shown.

[0033]

[TABLE 1]

Transfer Amount	Liquid Absorbing Condition	Condition of Printing Surface
less than 0.27g	Absorbable	Durability insufficient
0.33g	Absorbable	Durability sufficient
0.40g	Absorbable if left	Durability Sufficient
0.40g or more	Not absorbable	Durability sufficient and image quality lowered

[0034]

In the present invention, liquid transfer operation capable of applying an appropriate amount of liquid to the recording medium is realized with construction illustrated in preferred embodiments.

[0035]

(First Embodiment)

The first embodiment of a liquid transfer device according to the present invention will be discussed hereinafter with reference to Figs. 3 to 6.

Fig. 3(a) is a perspective view showing a construction of the first embodiment of the liquid transfer device, and Fig. 3(b) is a section of the liquid transfer device shown in Fig. 3(a), and Fig. 4 is an exploded perspective view of the liquid transfer device of Fig. 3.

[0036]

The first embodiment of the liquid transfer device 1 is constructed with a liquid transfer member 2 accumulating a liquid for enhancing durability of a printed product and transferring the liquid on a printed surface of the printed product, and a holding member 3 holding a circumference of the liquid transfer member 2.

The liquid transfer member 2 is constituted by a quadrangular sheet form liquid accumulating member (liquid accumulating portion) 4, which is formed from a fibrous body or a foamed sponge having a predetermined elasticity, and a quadrangular porous film 5 tightly fitted on one surface (front surface/outer surface side) of the liquid accumulating member 4 for covering the latter.

[0037]

Here, the liquid accumulating member 4 has

substantially uniform thickness, elasticity and density over the entire region and has a single layer structure. In this embodiment, a fibrous body is selected in consideration of shelf life. As a fibrous body, PP (polypropylene), PET (polyethylene terephthalate) or the like may be used. Here, PET having higher liquid holding ability is selected.

[0038]

On the other hand, a density of the fibrous body determines large and small of liquid holding ability (capillary force) and elastic force depending upon high and low. Large and small of the liquid holding ability and elastic force determine large and small of discharge amount of the liquid contained therein and number of times of liquid to be transferred, as shown in table 2. Density of the fibers has to be appropriately selected depending upon number of times of transferring and exuding ability of the liquid and so forth. In the shown embodiment, assuming the printed product of the post card size, the fibrous body of the size 178 mm (longitudinal) × 130 mm (lateral) × 4.0 mm (thick), and practically applicable density of the fibrous body of this size is in a range of 0.06 g/cc to 0.4 g/cc. In the first embodiment, the density of the fibrous body is 0.2 g/cc.

[0039]

On the other hand, the porous film 5 is formed

from PTFE (polytetrafluoroethylene) film formed with pores permitting the liquid to pass, over the entire surface. In the case of the liquid having the foregoing viscosity 10 to 400 cp (centipoises: 0.01 to 0.4 Pa·s), it is desirable that pore size formed in the porous film 5 is in a range of 0.1 to 3 μm, preferably 0.1 to 1 μm, and thickness is 50 to 200 μm. It should be noted that when pore size of the porous film 5 is larger, liquid permeability becomes higher. Therefore, if the pore size becomes too large, exuding amount of the liquid to the surface of the porous film 5 from the liquid accumulating member 4 becomes excessive, and if the pore size becomes too small, exuding amount of the liquid to the surface side of the porous film 5 lacks. In an experiment, an optimal exuding amount could be obtained when the pore size of the porous film 5 is set at 0.2 μm.

[0040]

On the other hand, making the thickness of the porous film 5 appropriate is important for avoiding occurrence of irregularity in transfer. Namely, when the porous film 5 is thin, the porous film becomes less elastic to easily cause deformation to easily cause transfer irregularity upon transfer to the printing medium. Conversely, when the porous film is excessively thick, elasticity becomes excessively high to be hardly deformed to cause difficulty in flexibly

contacting over the entire area upon transferring to the printing medium having bent or irregularity in shape. Even in this case, irregularity in transfer is easily caused. In the experiments, optimal transfer condition can be obtained without irregularity in transfer when the thickness of the porous film 5 is set at 80 μm.

[0041]

It should be noted that a relationship of liquid holding ability of the porous film, the liquid accumulating member and the printed product is:

printed product > porous film > liquid accumulating member.

[0042]

On the other hand, the holding member 3 holding the foregoing liquid accumulating member 2 is constructed with a quadrangular surface supporting frame 6 bonded on the surface of the porous film 5 by an adhesive 60, a container form receptacle member 7 for receiving the liquid accumulating member 2, a lid 8 for covering an opening portion of the surface supporting frame 6 for opening and closing, and a connecting member 9 connecting the lid 8 and the receptacle member 7.

[0043]

Amongst, the surface supporting frame 6 is formed with a plate member of PET having appropriate

rigidity and thickness. The surface supporting frame 6 projects outwardly from the porous film 5, and is formed with a quadrangular opening portion 6a for exposing the porous film 5 housed inside of the surface supporting frame 6. It should be noted that thickness of the surface supporting frame 6 is set at 0.75 mm. On the other hand, the receptacle member 7 is formed into a container shape by vacuum molding of semi-transparent PET sheet having thickness of about 0.2 mm. A frame form connecting portion 7a projected along the opening portion is welded on the lower surface of the surface supporting frame. By this, the liquid transfer member 2 is received within a receptacle space defined by the receptacle member 7 and the surface supporting frame 6 in a condition impossible to dropout and exposing the surface of the liquid accumulating member 2 through the opening portion of the surface supporting frame 6. It should be noted that the reference numeral 6b shows an end face forming the opening portion 6a of the surface supporting frame 6, and the reference numeral 6c shows a recessed portion formed in each end face 6b for facilitating taking out of the printing medium inserted within the opening portion 6a.

[0044]

Here, a manufacturing process of the liquid transfer device constructed as set forth above, will

be discussed with reference to Fig. 5. At first, the adhesive 60 is applied on a bottom surface of the surface support frame 6 along the opening portion 6a. With the adhesive 60, the surface supporting frame 6 is bonded on the surface of the porous film 5 (having dimension of 168 mm × 126 mm × 0.08 mm) (see Figs. 5(a), 5(b) and 5(c)). Next, the porous film 5 fixed on the surface supporting frame 6 is fitted on the surface of the liquid accumulating member (having dimension of 178 mm × 130 mm × 4.0 mm) 4. Then, these three members are housed within the receptacle member 7. Here, the bottom surface of the surface supporting frame 6 and a mating portion 7a of the receptacle member 7 are fitted and joined together by heat seal. At this timing, for a portion of the quadrangular mating portion 7a, a non-heat sealed portion is formed to serve as liquid pouring opening. A liquid supply tube connected to a predetermined liquid supply source is inserted into the liquid pouring opening to pour the liquid to the liquid accumulating member 4. Subsequently, the liquid supply tube is drawn out, and in place, a suction tube connected to a predetermined vacuum source is inserted to discharge inside air. At a timing reaching a given reduced pressure, the suction tube is drawn out to close the liquid pouring opening by heat seal.

[0045]

Subsequently, the lid 8 is connected to the receptacle member 7 by the connecting member 9 which is welded on the lid 8 at one end and welded on the lower surface of the mating portion 7a of the receptacle member 7 at the other end (see Fig. 5(g)). Thus, manufacturing of the liquid transfer device is completed.

[0046]

Next, procedure of transferring of the liquid on the print medium using the liquid transfer device will be discussed with reference to Fig. 6.

At first, the printed product to which is applied ink in the ink receptacle layer by an ink-jet printing apparatus or the like, is prepared. Here, it is desired that the printed product PM is in a condition where solvent and moisture content contained in the ink is sufficiently evaporated. It has been confirmed that the solvent and moisture content in the liquid are completely evaporated from the ink receptacle layer after about thirty minutes from completion of printing, in normal case.

[0047]

On the other hand, in the liquid transfer device 1, the liquid accumulated in the liquid accumulating member 4 is drawn toward inside of the pores by the porous film 1 having greater liquid holding ability (capillary force) than the liquid accumulating member

4.

During the use, the lid 8 is opened to mount the printed product on the transfer surface of the porous film 5 exposed from the opening portion 6a of the surface supporting frame 6 in a condition where the surface of the porous film 5 and the printed surface are contacted (see Fig. 6(a)). Subsequently, the lid 8 is closed to cover the printed product PM. A pallet S is urged onto the lid 8 and reciprocally moved for several times to tightly fitting the printed surface of the printing product PM and the porous film 5 (see Fig. 6(b)).

[0048]

By a depression force from the pallet S, the liquid accumulating member 4 is elastically deformed downwardly. Then, by this elastic deformation, the liquid accumulated therein is pushed out toward the surface side (printed product side). On the other hand, between the liquid accumulating member 4 and the printed surface (ink receptacle layer) of the printed product PM, the porous film 5 is present. The liquid flow toward the printing medium pushed out from the liquid accumulating member 4 is restricted by the porous film 5 so that the liquid is transferred to the printing product in just proportion. In the first embodiment, the liquid accumulating member 4 has elasticity and the porous film 5 has flexibility.

Therefore, when bending or irregularity of shape are present in the printed product PM, the entire surface of the porous film 5 is flexibly follows the surface of the printed product PM. Thus, the liquid is uniformly transferred over the entire printed surface of the printed product PM.

[0049]

It should be appreciated that, when the liquid accumulating member are directly contacted with the printed product PM without providing the porous film 5, unlike in the first embodiment, large amount of liquid pushed out from the liquid accumulating member can be transferred to the printed product to possibly require wiping.

[0050]

As set forth above, after sufficiently contacting the printed product PM on the porous film 5, the printed product PM is removed from the porous film 5. The printed product PM is tightly fitted on the surface of the porous film 5 and stuck thereon by viscosity of the liquid. Therefore, upon removal from the surface of the porous film 5, a finger is hooked at an end portion of the printed product PM to peel off from the end (Fig. 6(c)). At this time, even when little gap is present between the surface support frame 6 and the printed product, the finger may be inserted through the recessed portion 6c of the

surface supporting frame 6 to easily hook the finger to the end edge of the printed product PM, permitting smooth removal of the printed product PM without causing injury of the transfer surface (see Fig. 6(d)).

[0051]

Here, in the above-described embodiment, a result of experiments checking relationship between number of times of appropriate transfer (transferable number), the condition of the liquid exuded from the liquid accumulating member in the initial condition immediately after completion of the liquid supply for the liquid accumulating member (an initial exuding amount), and liquid holding ability of the liquid accumulating member, is shown in the following table 2.

[0052]

[TABLE 2]

Density (g/cc)	Transferable Number	Initial Exuding Amount	Liquid Holding Ability
0.4	20 to 30 times	Appropriate	Sufficient
0.2	30 to 50 times	Appropriate	Sufficient
0.1	30 to 70 times	Excessive	Sufficient
0.06	100 times	Excessive	Insufficient

[0053]

As can be clear from TABLE 2, higher density of the liquid accumulating member results in higher stiffness to increase difficulty in causing elastic

deformation (difficult to squeeze) to make a liquid holding ability by a capillary force higher. Accordingly, an exuding liquid amount is decreased according to increasing of density of the liquid accumulating member. On the other hand, lowering of the density of the liquid accumulating member makes easier to cause elastic deformation (easier to squeeze) to lower the liquid holding ability to increase the exuding liquid amount upon transfer. By this experiments, when the density of the liquid accumulating member is less than or equal to 0.1 g/cc, the initial exuding amount became excessive. On the other hand, when the density of the liquid accumulating member is less than or equal to 0.06 g/cc, transferable number becomes more than or equal to hundred times. However, a sufficient liquid holding ability (capillary force) cannot be obtained to make the initial liquid exuding amount excessively large. If the liquid transfer device is tilted even slightly, the liquid flows downwardly to cause local concentration to make uniform liquid supply impossible. Therefore, in the shown embodiment, density of the liquid accumulating member is set at 0.2 g/cc.

[0054]

(Test for Printed Product after Liquid Transfer)

For the printed product transferred liquid in the first embodiment of the liquid transfer device, a

measurement test of image density and an accelerated life test were performed.

In this tests, the printed product on which a photographic image was printed on a printing medium having an ink receptacle layer of pseudoboehmite using an ink-jet printer BJF870 by Canon Inc. as an ink-jet printer, was used. As a printing medium, one prepared by providing a reflection layer (about 15 μm thick layer of $BaSO_4$) and a 30 μm thick ink receptacle layer formed of pseudoboehmite alumina, was used. On the printing medium set forth above, printing was performed using an ink containing dye type coloring agents for the printer set forth above to obtain a printed product carrying the printed image by absorbing coloring agents in the ink receptacle layer containing alumina. In the ink receptacle layer after printing, void to absorb the liquid was remained.

[0055]

On the other hand, as an image protecting liquid, transparent and odorless fatty acid ester (ODO manufactured by Nisshin Seiyu Co., Ltd., tradename) removed unsaturated component causing yellow-tinging and odor, was used among fat and oils to transfer over the entire printed surface of the printed product by the liquid transfer device.

[0056]

It should be noted that respective tests were

performed under the following conditions.

(1) Image Density Measuring Test

The image density was measured by a reflection type photometer RD-918 (tradename) available from MacBeth Corporation. Measured image density was expressed by OD (Optical Density) of black portion of the image.

(2) Accelerated Life Test

Using Ozone Weather Meter (tradename) available from Suga Tester Kabushiki Kaisha, image density value (OD value) was measured after exposure process of two hours under atmosphere of 3 ppm of ozone to derive variation rate of OD before and after exposure (ΔE = {[OD after exposure - OD before exposure]/[OD before exposure]} × 100) for evaluation of light fastness.

(3) Result

For comparison with the first embodiment, ΔE value in silver halide photograph was measured. The value was about 0.2. In contrast to this, ΔE value obtained by the first embodiment was 0.2. The image transferred the liquid by the first embodiment of the liquid transfer device 1 is predicted to have comparable durability as silver halide photograph under exposure to atmosphere. This indicates that the silver halide photograph causes discoloration under exposure to atmosphere in two to several tens years, and the image provided protection treatment by the

first embodiment of the liquid transfer device 1 can enjoy the initial image quality over the comparable period as the silver halide photograph.

[0057]

As set forth above, by providing the foregoing protection treatment by the shown embodiment of the liquid transfer device 1, the raw image can be enjoyed over a long period without presence of the protecting member, such as glass or film.

[0058]

(Second Embodiment)

Next, a second embodiment of a liquid transfer device 20 according to the present invention will be discussed with reference to Figs. 7 to 10. It should be noted that like components to those discussed in connection with the first embodiment will be identified by like reference numerals in Figs. 7 to 10.

[0059]

The second embodiment of the liquid transfer device is constructed with the liquid transfer member accumulating a liquid for enhancing durability of a printed product and transferring the liquid on the printed surface of the printed product, and the holding member holding a circumference of the liquid transfer member similarly to the first embodiment. It should be noted that while the liquid accumulating member in the first embodiment has a single layer

structure, the second embodiment of the liquid accumulating member has a structure of plurality of layers (two layers) having mutually different liquid holding ability (capillary force). This point is first different from the first embodiment. Namely, as shown in Fig. 7(b), the liquid accumulating member 24 in the second embodiment has a first layer 24a formed from a sheet form member having relatively low density (0.065 g/cc) and a second layer 24b formed from a sheet form member fitted on a (upper) surface of the first layer 24a and having relatively high density (0.2 g/cc). On the other hand, a dimension of the first layer 24a is thicker than the second layer 24b and has greater area. Here, the dimension (longitudinal dimension × lateral dimension × thickness) of the first layer 24a is 178 mm × 130 mm × 4.0 mm, and the dimension (longitudinal dimension × lateral dimension × thickness) of the second layer 24b is 150 mm × 106 mm × 1.5 mm.

[0060]

A surface (upper surface) of the liquid accumulating member 24 is covered with a porous film 25. With the porous film 25 and the liquid accumulating member 24, a liquid transfer member 22 is formed. The porous film 25 is formed from the material similar to that of the porous film 5 discussed in connection with the first embodiment.

The peripheral edge portion of the porous film 25 is secured to the bottom surface (lower surface) of the quadrangular surface supporting frame 6 forming a part of the holding member 13.

[0061]

On the other hand, the holding member 13 receiving the liquid transfer member 22 includes a contact plate 27 having a predetermined thickness (1.5 mm) secured along one edge of the surface supporting frame 6. Except for that, in the holding member 13, similar to the first embodiment, the surface supporting frame 6, the receptacle member 7, the lid 8, the connecting member and so forth are included. With such holding member 13, the liquid transfer member 22 can be retained without causing drop out.

[0062]

It should be noted that, in the second embodiment, within the opening portion 6a of the surface supporting frame 6, the second layer 24b as covered by the porous film 25 is engaged for allowing the porous film 25 and the second layer 24b to project upwardly from the surface of the surface supporting frame 6. Then, the printed product PM is mounted on the surface of the porous film 25 projecting upwardly. The contact plate 27 is used for readily positioning the printed product when the printed product is mounted on the transfer zone. The contact plate 27 is

formed with a recessed portion 27a for facilitating removal of the printed product.

[0063]

Next, discussion will be given for procedure in manufacturing of the second embodiment of the liquid transfer device 20.

First, the surface supporting frame 6, the porous film 25 and the second layer 24a are prepared. After covering the surface of the second layer with the porous film 25, the second layer 24b covered with the porous film 25 is inserted into the opening portion 6a of the surface supporting frame 6 (see Figs. 9(a), 9(b) and 9(c)). Then, the peripheral edge of the porous film 25 projecting downwardly from the surface supporting frame 6 is bent along the opening portion 6a of the surface supporting frame 6. A bent portion is bonded to the surface supporting frame 6 by adhesive 60. Furthermore, the contact plate 27 is bonded on the surface of the surface supporting frame 6. These four members are placed on the first layer via the adhesive 60 (see Figs. 9(d) and 9(e)).

[0064]

Next, the five members shown in Fig. 9(e) are received within the receptacle member 7. Then, the bottom surface of the surface supporting frame 6 and the mating portion 7a of the receptacle member 7 are overlaid with each other and bonded by heat seal

leaving the liquid pouring opening (see Fig. 9(f)). Subsequently, similarly to the first embodiment, pouring of the liquid into the liquid accumulating member 24 and discharging of internal air are performed using the liquid pouring opening. After discharging air, the liquid pouring opening is closed by heat seal. Finally, the lid 8 is connected to the receptacle member 7 via the connecting member 9 to complete the liquid transfer device 20 (see Fig. 9(g)).

[0065]

Even in the second embodiment of the liquid transfer device constructed as set forth above, an appropriate amount of liquid can be transferred to the printed product by quite simple operation, like in the first embodiment. In this case, the porous film 5 is exposed by opening the lid 8, and the printed product is mounted on the porous film 5 holding the liquid in contact with a receiving surface of the printed product. Next, the lid 8 is closed and the printed product is depressed for several times through the lid 8 by the pallet. Again, by opening the lid 8 again, the printed product is peeled off the porous film 5 and is removed (see Fig. 10(d)).

[0066]

In the liquid transfer process, by applying depression force by the pallet S, the first layer 24a having low density is caused elastic deformation in

greater magnitude than that of the second layer 24b to exude relatively large amount of liquid held therein by elastic deformation toward the surface side (upper side). The liquid exuded from the second layer 24b is sucked by the higher density layer 24b having greater liquid holding ability (capillary force). The sucked liquid is fed to the porous film 25 having higher liquid holding ability than that of the second layer 24b. Liquid in an appropriate amount from the lower side is transferred, while the exuding amount toward outside is restricted by the porous film 25, to the receptacle layer of the printing medium.

[0067]

As set forth above, in the second embodiment where the first layer 24a provided lower density (easily squeezed and having lower liquid holding ability) is provided, the liquid can be smoothly fed toward the porous film 25. Accordingly, even without applying large depression force by the pallet S, the liquid can be supplied. In other words, when remaining amount of liquid in the liquid accumulating member 24 becomes small, smooth liquid transfer can be realized since the first layer 24a can be elastically deformed easily. Thus, transferable number can be increased as compared with that in the first embodiment. In experiments, for the first and second embodiments of the liquid transfer device, the liquid

was supplied to establish the same liquid accumulation amount, and number of times of liquid transfer was counted. As a result, when about 30 to 50 times of liquid transfer was possible in the first embodiment, about 70 times of liquid transfer was possible in the second embodiment.

[0068]

On the other hand, since the first layer 24a easily causes elastic deformation, even when bending or irregularity of shape are present in the printed product PM, the porous film 25 may be fitted to the surface of the printed product PM more flexibly to further ensure uniform liquid transfer in comparison with the first embodiment.

[0069]

It should be noted that while the liquid accumulating member 24 is formed by laminating two sheet form members having mutually different densities in the second embodiment, it is also possible to provide different density in the thickness direction of the liquid accumulating member even with the single member. For example, by compressing and heating one surface side of the single member, density can be differentiated in the single member. Accordingly, depending upon manner of application of the pressure, it is possible to provide different density in upper and lower two stages or, in the alternative, to

provide gradient in density so as to gradually vary the density from the front surface side to the back surface side. Then, even in this case, similar effect can be obtained to the case where two members having different densities are laminated as in the shown embodiment.

[0070]

(Third Embodiment)

Next, a third embodiment of the liquid transfer device according to the present invention will be discussed.

In the foregoing first embodiment and the second embodiment, the receptacle member 7 and the lid 8 are formed separately and connected by the connecting member 9. The lid and the receptacle member may be formed integrally as the third embodiment of the liquid transfer device 30 according to the present invention as shown in Figs. 11 and 12.

[0071]

Namely, in the third embodiment, in the holding member 23 holding the liquid transfer member 22 similar to the second embodiment, the lid 8 and the receptacle member 7 are molded integrally by vacuum molding. Accordingly, with the third embodiment, the lid 8 and the receptacle member 7 can be molded in one process step. Also, steps of forming the connecting member and connecting the lid and the receptacle

member with the connecting member can be eliminated to permit manufacturing at lower cost. The lid 8 in the third embodiment is always provided with three-dimensional shape complementary with the shape of the upper surface of the liquid transfer member 22. It should be noted that like components to those discussed in connection with the second embodiment will be identified by like reference numerals.

[0072]

(Fourth Embodiment)

Next, a fourth embodiment of the liquid transfer device according to the present invention will be discussed with reference to Figs. 13 and 14.

The fourth embodiment is formed by forming a plurality of stripe form grooves 45 or 46 with a given interval on the lower surface of a liquid accumulating member (see Fig. 14(a)) in the third embodiment set forth above, as shown in Figs. 14(b) and 14(c). These grooves 45 or 46 are formed along a direction of gravity upon orienting the liquid transfer device 40 vertically. Upon orienting the liquid transfer device 40 vertically, the longitudinal direction is normally oriented in vertical direction. The grooves 45 or 46 are formed along the longitudinal direction of the liquid accumulating member 44.

[0073]

Here, the grooves 45 shown in Fig. 14(b) are the

grooves of cross-sectionally V-shaped configuration. These grooves may be formed by urging a hot wire developing Joule heat or cutting the lower surface of the liquid accumulating member 44 shown in Fig. 14(a).

[0074]

With a liquid accumulating member 44V formed with the cross-sectionally V-shaped grooves 45, cushioning characteristics of the liquid accumulating member can be enhanced in vertical direction (thickness direction) by the grooves, as shown by arrow. Therefore, even when a material having relatively high density and relatively high liquid holding ability, exuding ability of liquid during liquid transferring operation can be enhanced by the cushioning characteristics to permit increasing of the number of times of liquid transfer. On the other hand, when a material having high liquid holding ability is used, local concentration of the liquid to the lower portion can be reduced even when the liquid transfer device 40 is oriented vertically. Furthermore, locally concentrated liquid in the lower portion can be smoothly dispersed over the entire area along the grooves 45 when the liquid transfer device 44 is returned to horizontal orientation. Thus, liquid transfer operation can be started or resumed quickly.

[0075]

On the other hand, cross-sectionally U-shaped

grooves 46 shown in Fig. 14(c) may be easily formed by urging a hot wire developing Joule heat. Such cross-sectionally U-shaped grooves 46 may enhance cushioning characteristics of the liquid transfer member 44U similarly to the case where the cross-sectionally V-shaped grooves 45 are formed. Also, the cross-sectionally U-shaped recessed portions may enhance flowability of the liquid in comparison with the recessed portions having V-shaped cross-section. Therefore, when the liquid transfer device 40 is returned to be used in horizontal orientation, the liquid can be distributed over the entire area of the liquid accumulating member 44U more quickly.

[0076]

It should be noted that, the fourth embodiment is formed by forming the grooves 45 or 46 on the bottom surface of the first layer 24a and the second layer 24b forming the liquid accumulating member 24 in the third embodiment, as shown in Fig. 13. However, the grooves 46 or 46 can be formed in other embodiment. For example, the V-shaped or U-shaped grooves may be formed on the bottom surface of the liquid accumulating member 4 of a single layer structure shown in the first embodiment. Even in this case, similar effect to the fourth embodiment can be expected.

[0077]

(Fifth Embodiment)

Next, a fifth embodiment of the liquid transfer device according to the present invention will be discussed.

As shown in Fig. 15, the fifth embodiment of the liquid transfer device 50 is constructed with a liquid transfer member 52 transferring the liquid to the printed product, and the holding member 53 receiving and holding the liquid transfer member 52. The liquid transfer member 52 is formed with a quadrangular liquid accumulating member 54 formed from the fibrous body or foamed sponge, a porous film 55 covering top surface, side surfaces and a part of bottom surface of the liquid accumulating member 54 and a holding plate 56 covering the bottom surface of the porous film 55. Here, the porous film 55 is formed of the material similar to the foregoing embodiments. On the other hand, the holding member 5 is constructed with a lower casing portion 57 in quadrangular shape in plan view holding the liquid accumulating member 54, an upper casing portion 58 covering the opening portion of the lower casing portion 57 for opening and closing, and a hinge 59 connecting the both casing portions 57 and 58. Both casing portions are formed from a resin having rigidity or other material.

[0078]

On the other hand, the holding plate 53 of the

liquid accumulating member 52 is fixed to the inner surface of the bottom portion of the lower casing portion 57. In the condition where the upper casing 58 is opened, an upper half portion of the liquid accumulating member 52 is projected upwardly from the opening portion of the lower casing portion 57 to expose the transfer surface. On the other hand, by closing the upper casing body 58, the liquid accumulating member 52 is protected as being completely covered by both casing portions. Therefore, damaging, liquid leakage and so on due to exertion of an external force can be successfully avoided.

[0079]

In use, the upper casing portion 58 is opened, and the printed product PM is mounted on porous member 55 in the transfer surface (liquid accumulating member) 52 projecting upwardly. Then the printed product PM is depressed by the pallet S to tightly fit the ink receptacle layer of the printed product PM onto the porous member to transfer the liquid. A dimension of the printed product which can be used, is not always required to be smaller than the area of the transfer surface but is applicable for the printed product having size greater than the transfer surface,

[0080]

By the way, Figs. 17(a) to 17(d) are illustrations showing liquid transfer operation for a

large size printed product larger than the transfer surface. For the large size printed product PM shown in Fig. 17(a), liquid may be transferred over the entire area of the large size printed product PM by shifting the printed product relative to the transfer surface for a plurality of times as shown in Figs. 17(b) and 17(c). In this case, it is possible that the liquid is transferred in overlapping manner in certain regions of the printing medium. However, since the region where the liquid has been transferred once is lowered the liquid holding ability (capillary force) of the printed product, the liquid may not be transferred in excessive amount even by overlapping transfer. Therefore, it is not necessary to consider degradation of image by the overlapping transfer.

[0081]

By performing transfer with dividing into small regions, appropriate liquid transfer can be easily performed even for the large size printed product.

[0082]

[Advantageous Results of the Invention]

As described above, according to the present invention, it becomes possible to transfer the appropriate amount of liquid just in proportion to the printed product printed by the ink-jet printing apparatus, so that the durability of the image, which has been big problems to be solved in the ink-jet

printing apparatus, can be enhanced to be greater than that of the silver salt picture without forming the optical film, such as the glass and the resin on the printed product. Thus, the digital image of superior image quality can be formed at low cost utilizing the superior function of the ink-jet printing apparatus.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1]

Figs. 1(a), 1(b) and 1(c) are sections showing conditions of a printed product before and after transferring a protecting liquid on the printed product, wherein Fig. 1(a) shows a condition before transferring the liquid, Fig. 1(b) shows a condition immediately after transferring of the liquid and Fig. 1(c) shows a condition 2 to 5 minutes after transferring of the liquid.

[Fig. 2]

Figs. 2(a) and 2(b) are enlarged sections showing a condition of the printed product before and after transferring of an appropriate amount of the liquid on the printed product PM by the first embodiment of a liquid transfer device according to the present invention, wherein Fig. 2(a) shows a condition of the printed product in which a coloring agent penetrates into a receptacle layer, and Fig. 2(b) shows a condition where an appropriate amount of liquid is transferred and the liquid propagates over

the entire receptacle layer.

[Fig. 3]

Fig. 3(a) is a perspective view showing a construction of the first embodiment of a liquid transfer device according to the present invention; and Fig. 3(b) is a section of the liquid transfer device shown in Fig. 3(a).

[Fig. 4]

Fig. 4 is an exploded perspective view of the liquid transfer device shown in Fig. 3.

[Fig. 5]

Fig. 5 is a section showing assembling process of the liquid transfer device shown in Fig. 3.

[Fig. 6]

Fig. 6 is an illustration showing liquid transfer operation to be performed by the liquid transfer device shown in Fig. 3.

[Fig. 7]

Figs. 7(a) and 7(b) are illustrations showing a second embodiment of the liquid transfer device according to the present invention, wherein Fig. 7(a) is a perspective view of the liquid transfer device in the first embodiment, and Fig. 7(b) is a section of the liquid transfer device shown in Fig. 7(a).

[Fig. 8]

Fig. 8 is an exploded perspective view of the liquid transfer device shown in Fig. 7.

[Fig. 9]

Fig. 9 is a cross-sectional view showing assembling process of the liquid transfer device shown in Fig. 7.

[Fig. 10]

Fig. 10 is an illustration showing liquid transfer operation to be performed by the liquid transfer device shown in Fig. 7.

[Fig. 11]

Fig. 11 is a perspective view showing assembling process in a third embodiment of the liquid transfer device according to the present invention.

[Fig. 12]

Fig. 12 is a cross-sectional view of the liquid transfer device shown in Fig. 11.

[Fig. 13]

Fig. 13 is a perspective view showing assembling process of the liquid transfer device in a fourth embodiment according to the present invention.

[Fig. 14]

Fig. 14(a) is a perspective view showing a shape of bottom surface of the liquid holding member in the embodiments of the present invention shown in Figs. 1 to 12; and Figs. 14(b) and 14(c) are perspective views respectively showing a shape of the bottom surface of the liquid holding member in the fourth embodiment of the present invention, wherein Fig. 14(b) shows the

bottom surface of the liquid holding member formed with a sectionally V-shaped groove, and Fig. 14(c) shows the bottom surface of the liquid holding member formed with a sectionally U-shaped groove according to the present invention.

[Fig. 15]

Figs. 15(a) and 15(b) are illustrations showing a fifth embodiment of the liquid transfer device according to the present invention, wherein Fig. 15(a) is a perspective view and Fig. 15(b) are section.

[Fig. 16]

Fig. 16 is an exploded perspective view of the liquid transfer device shown in Fig. 15.

[Fig. 17]

Fig. 17 is a perspective view showing manners of respective operations to perform transfer the liquid to the printed product greater than a transfer surface using the liquid transfer device shown in Fig. 15.

[EXPLANATION OF REFERENCE NUMERALS]

M	recording medium
M1	base paper (support body)
M2	reflection layer
M3	receptacle layer
MP	printed product
CM	coloring agent
L	image protecting liquid
1	liquid transfer device

2 liquid transfer member

3 holding member

4 liquid accumulating member

5 porous film

6 surface supporting frame

6a opening portion

6b end face

6c recessed portion

7 receptacle member

8 lid

9 connecting member

13 holding member

20 liquid transfer device

22 liquid transfer member

23 holding member

24 liquid accumulating member

24a first layer

24b second layer

25 porous film

27 contact plate

27a recessed portion

30 liquid transfer device

40 liquid transfer device

44V first layer of liquid accumulating member

44U first layer of liquid accumulating member

45 V-shaped groove

46 U-shaped groove

50 liquid transfer device

52 liquid transfer member

53 holding member

54 liquid accumulating member

55 porous film

56 holding plate

57 lower casing portion

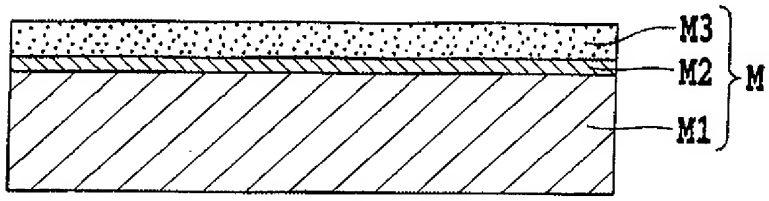
58 upper casing portion

59 hinge

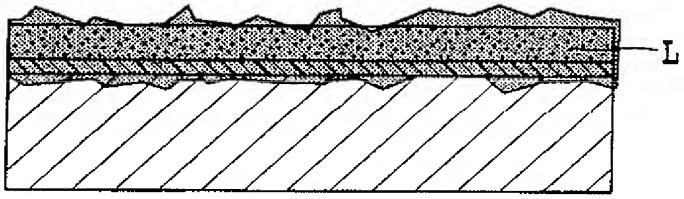
Drawing

(Fig.1)

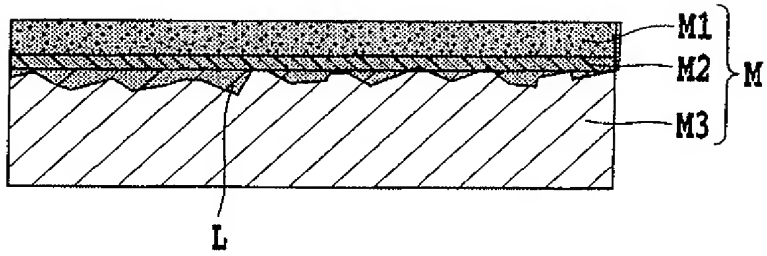
(a)



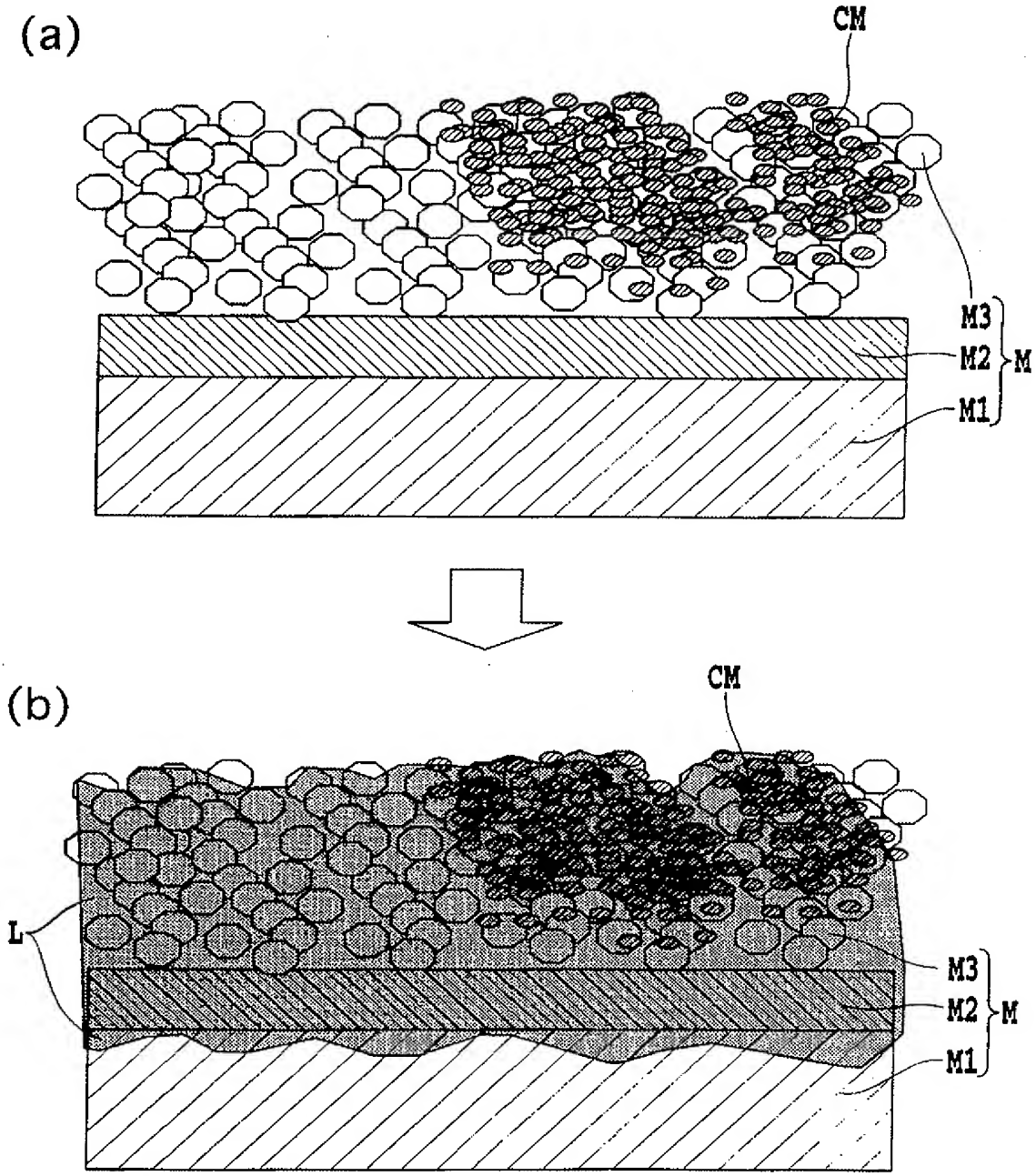
(b)



(c)

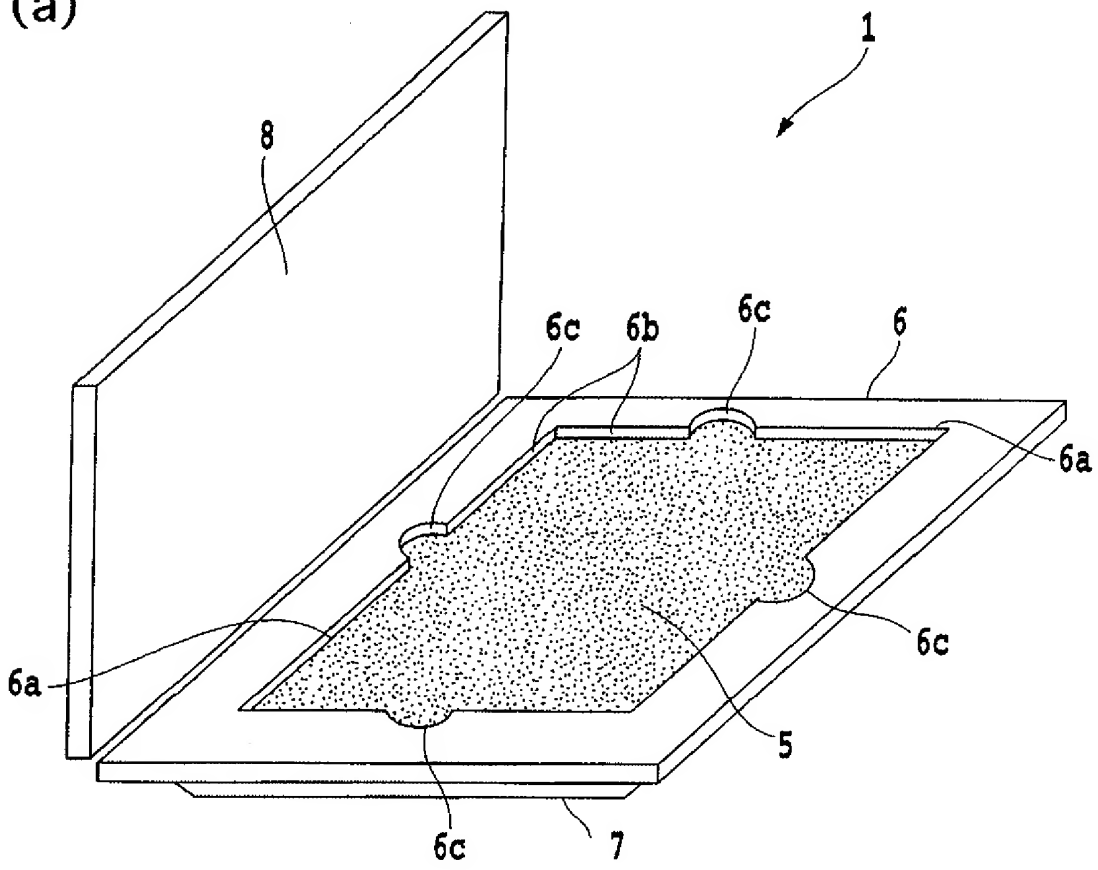


(Fig.2)

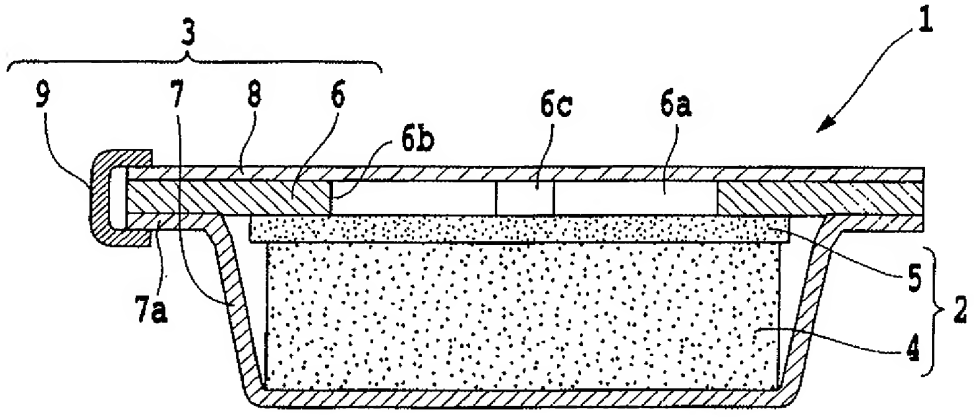


(Fig.3)

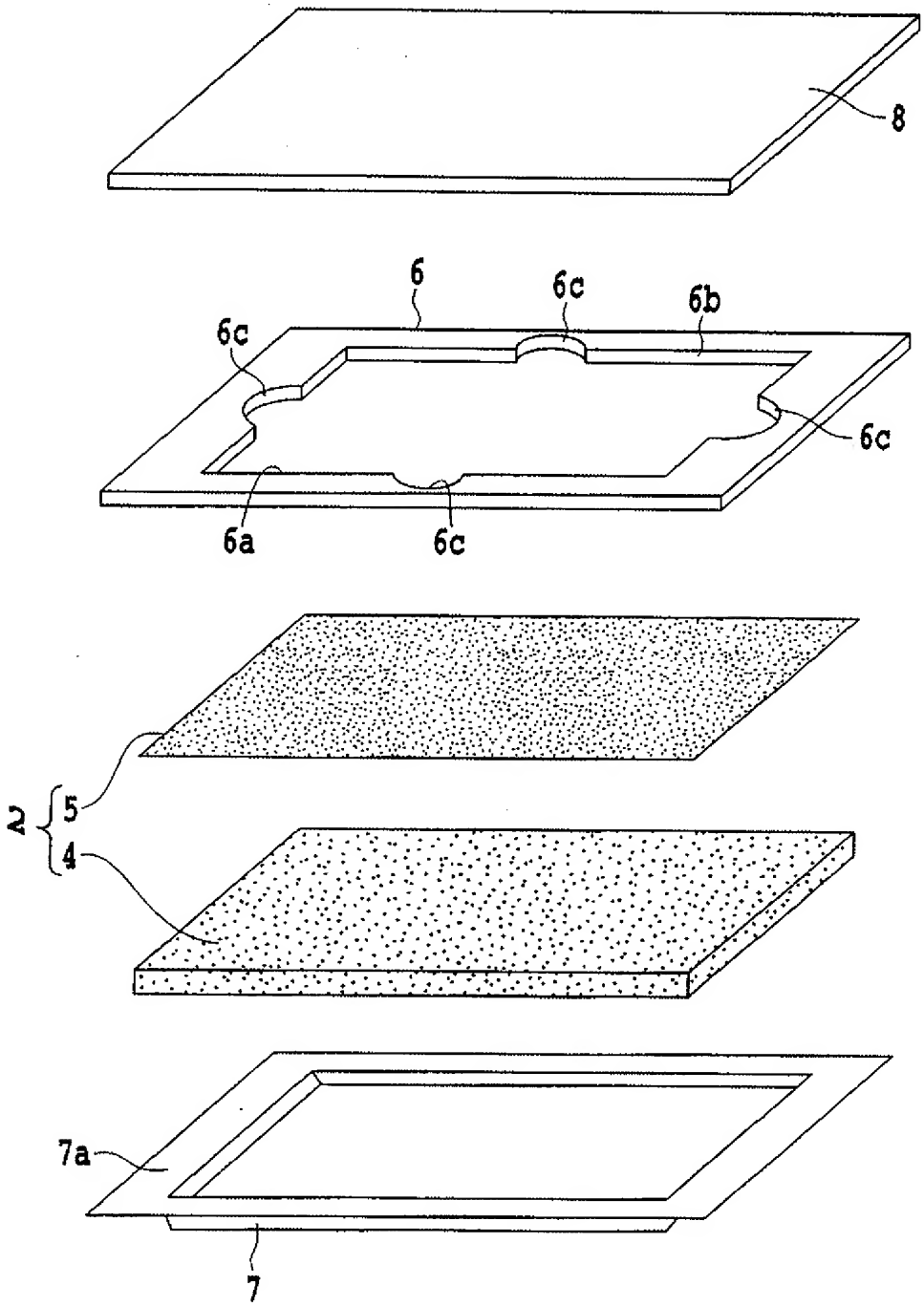
(a)



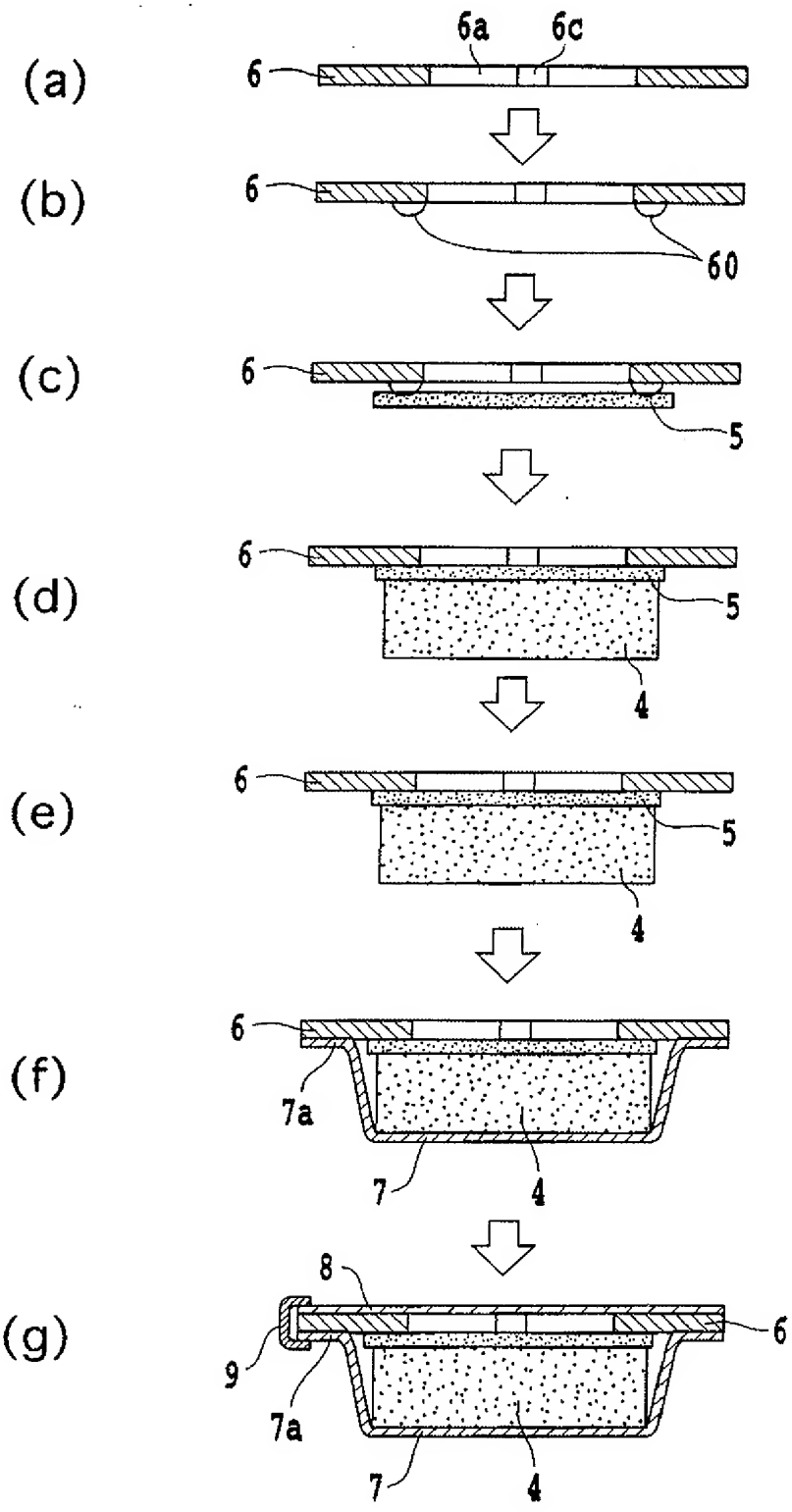
(b)



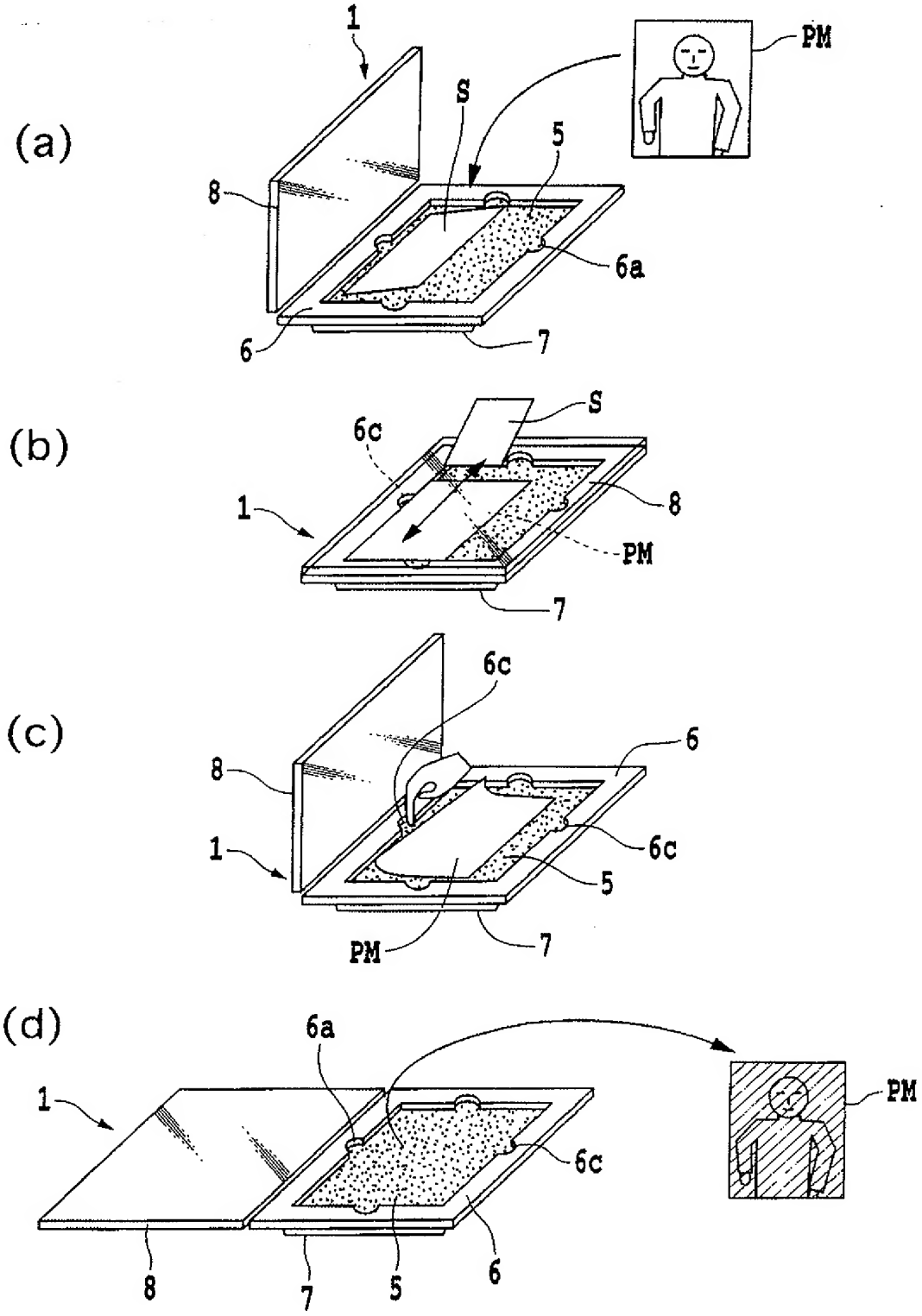
(Fig.4)



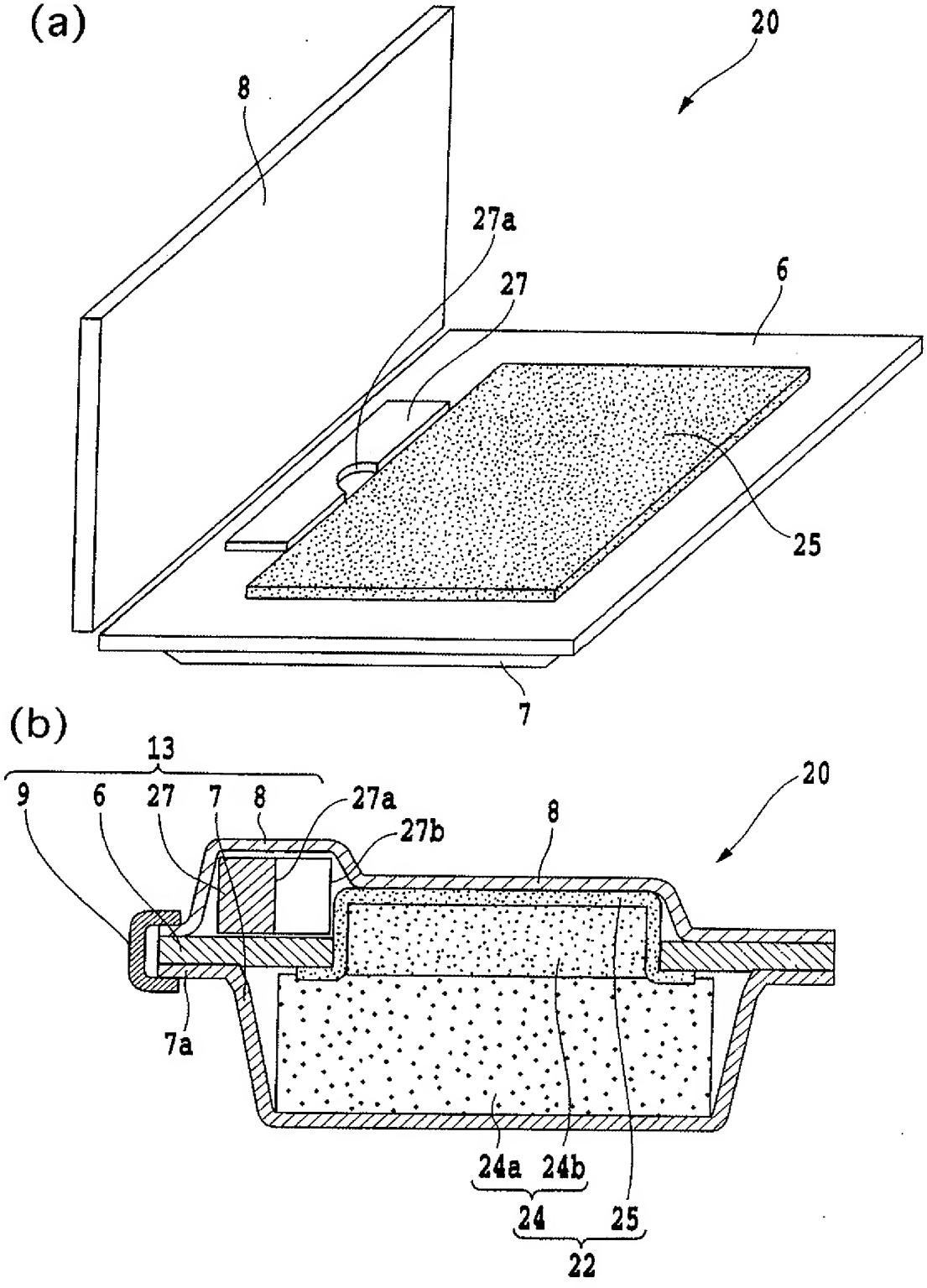
(Fig.5)



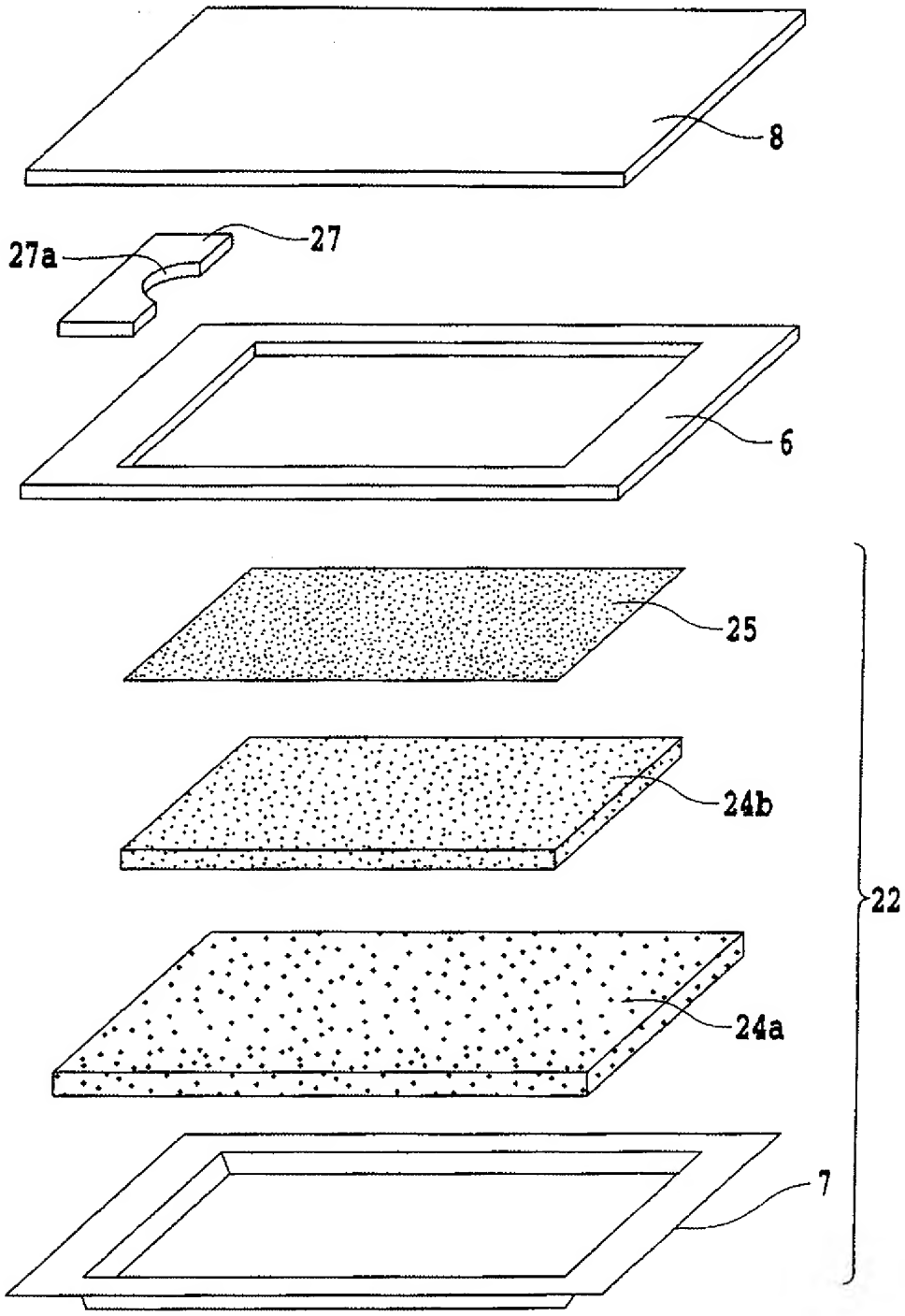
(Fig.6)



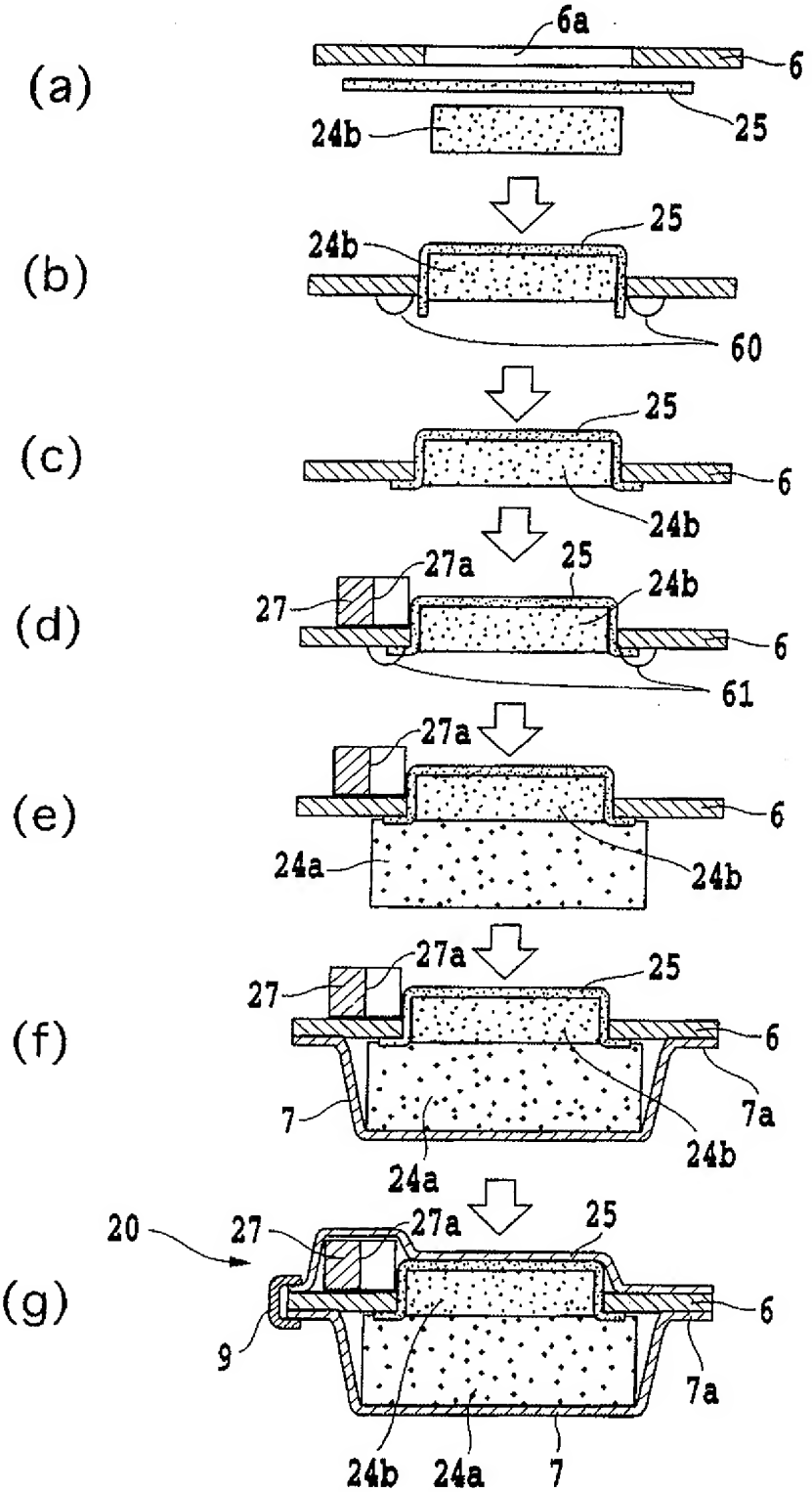
(Fig.7)



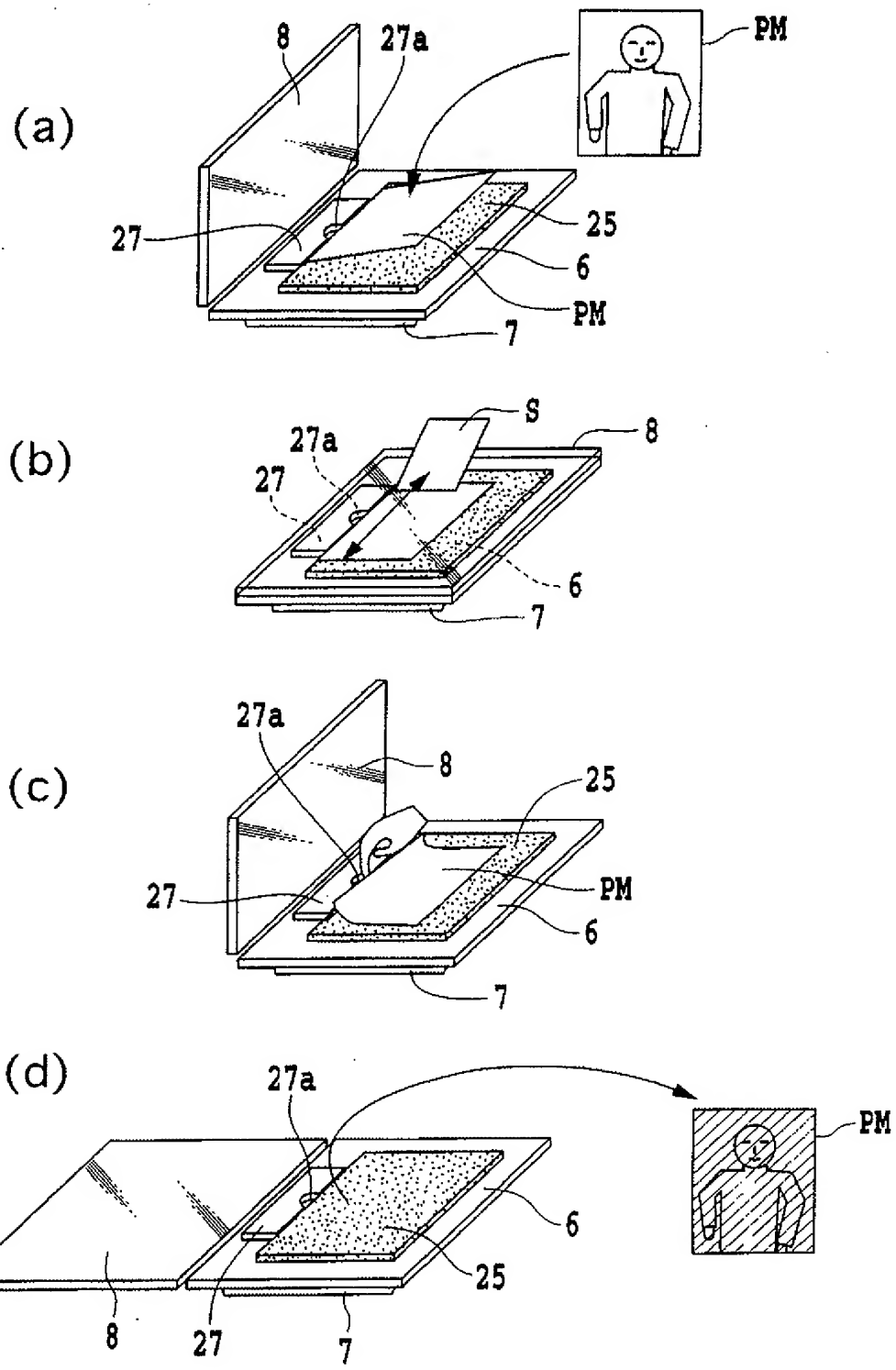
(Fig.8)



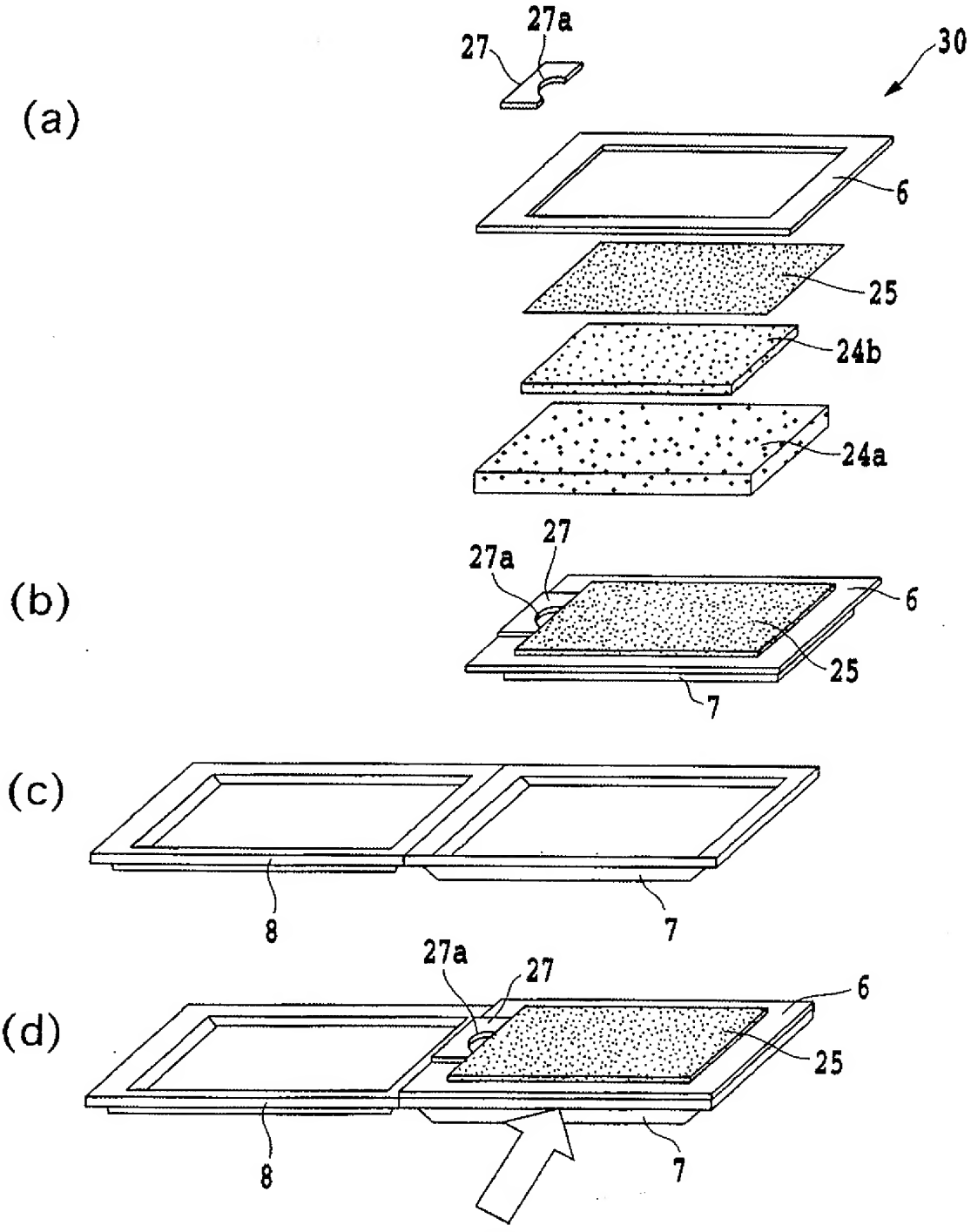
(Fig.9)


(a)
6a
6
24b
25
(b)
25
24b
60
(c)
25
6
24b
(d)
27a
25
24b
27
6
61
(e)
27a
6
24a
24b
(f)
27a
25
27
6
7
7a
24b
24a
(g)
20
27
27a
25
6
9
7a
24b
24a
7

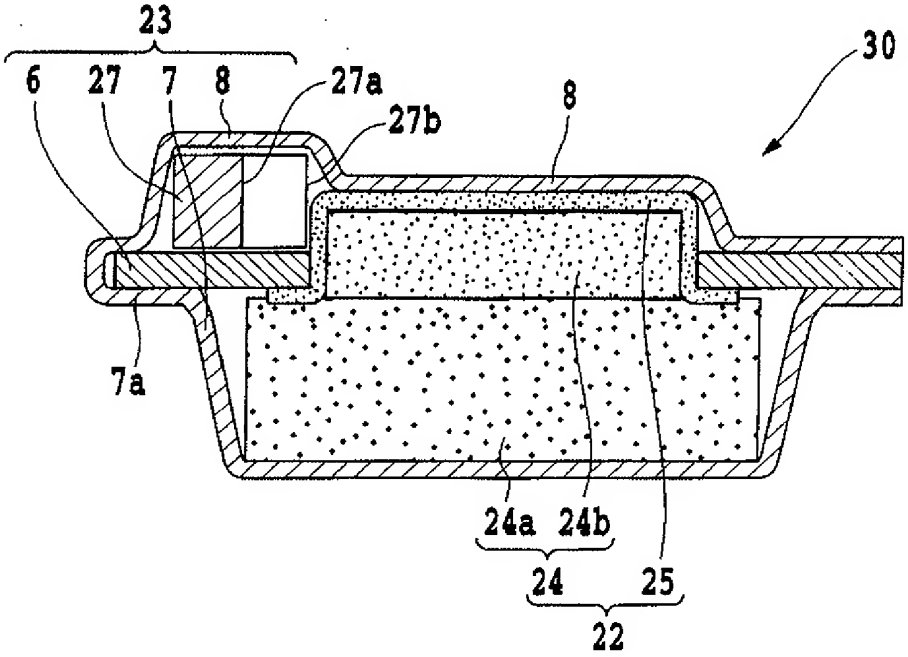
(Fig.10)


(a)
8
27a
PM
27
25
6
PM
7
(b)
S
8
27a
27
6
7
(c)
27a
8
25
27
PM
6
7
(d)
27a
PM
6
25
8
27
7

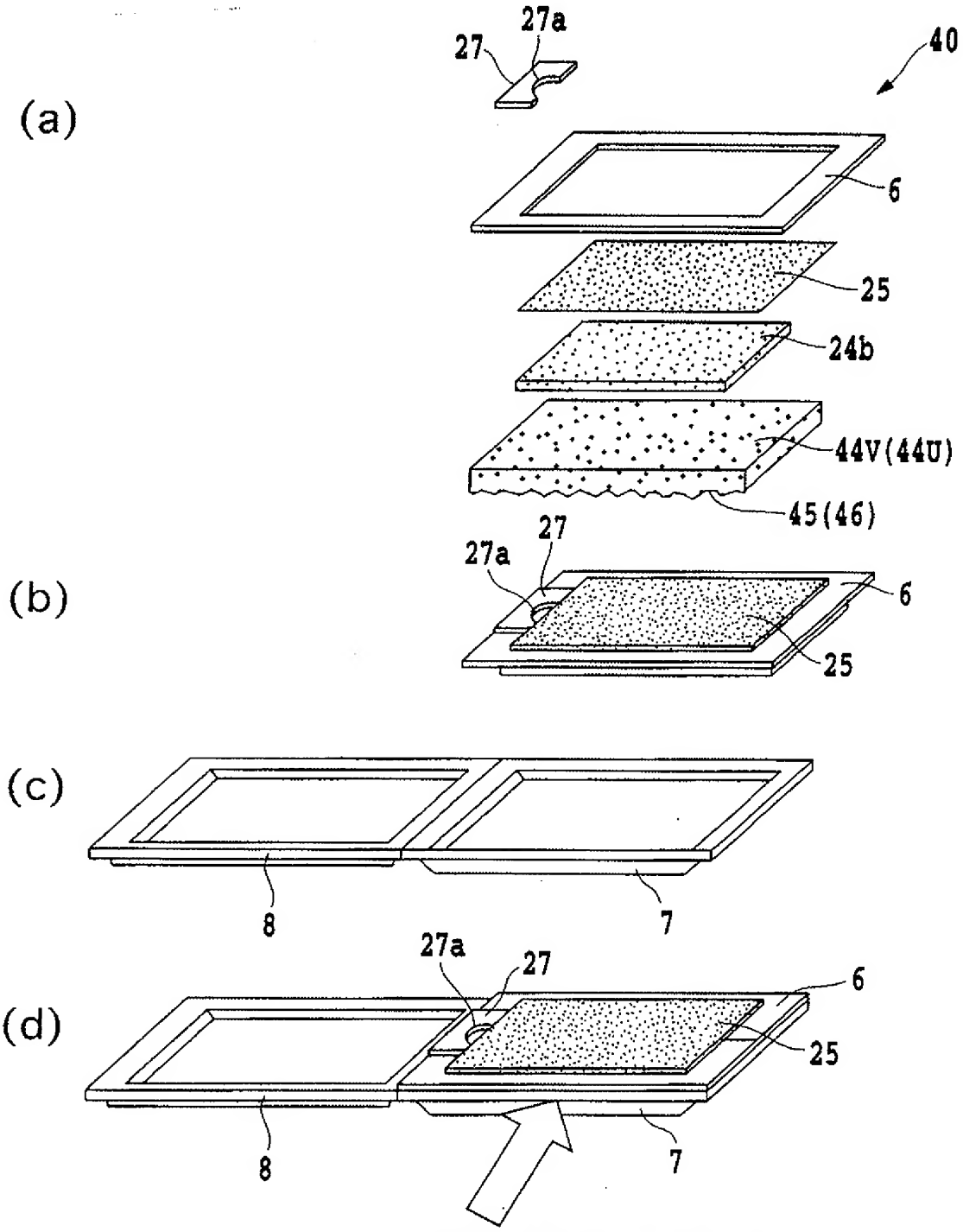
(Fig.11)


(a)
27a
27
30
6
25
24b
24a
(b)
27
27a
6
25
7
(c)
8
7
(d)
27a
27
6
25
8
7
inject and discharge liquid

(Fig.12)

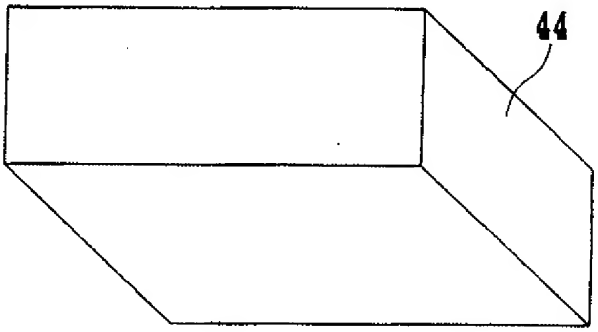


(Fig.13)

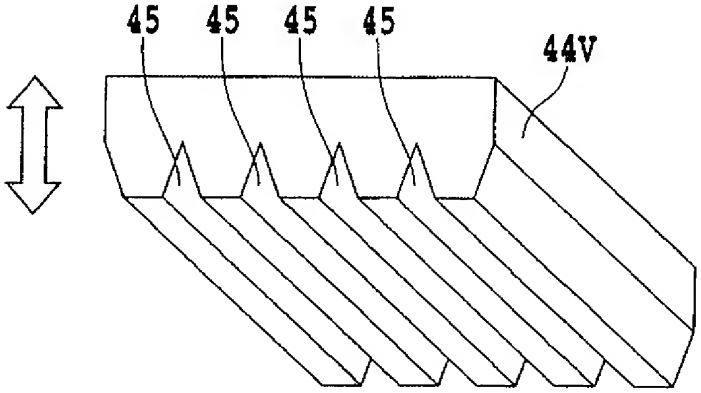

(a)
27a
27
40
6
25
24b
44V(44U)
45(46)
(b)
27
27a
6
25
(c)
8
7
(d)
27a
27
6
25
8
7
inject and discharge liquid

(Fig.14)

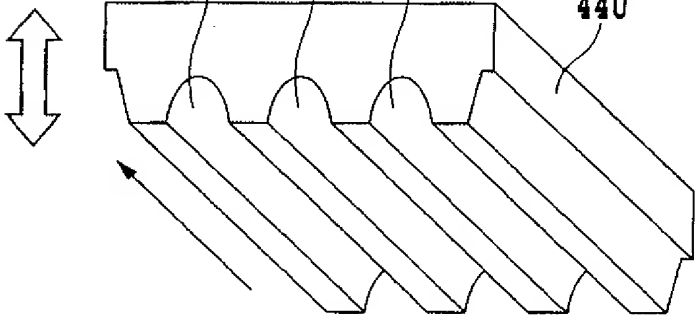
(a)



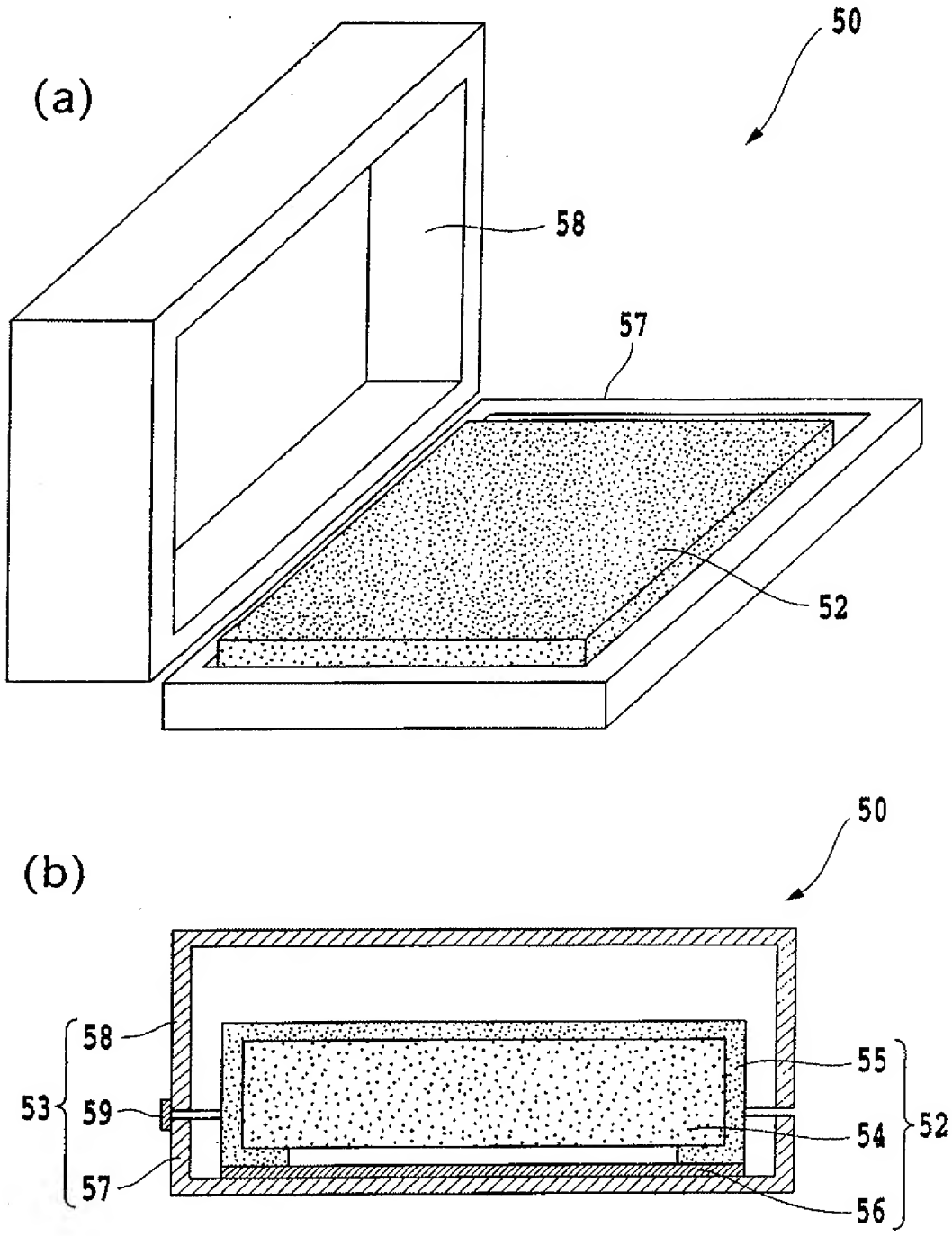
(b)



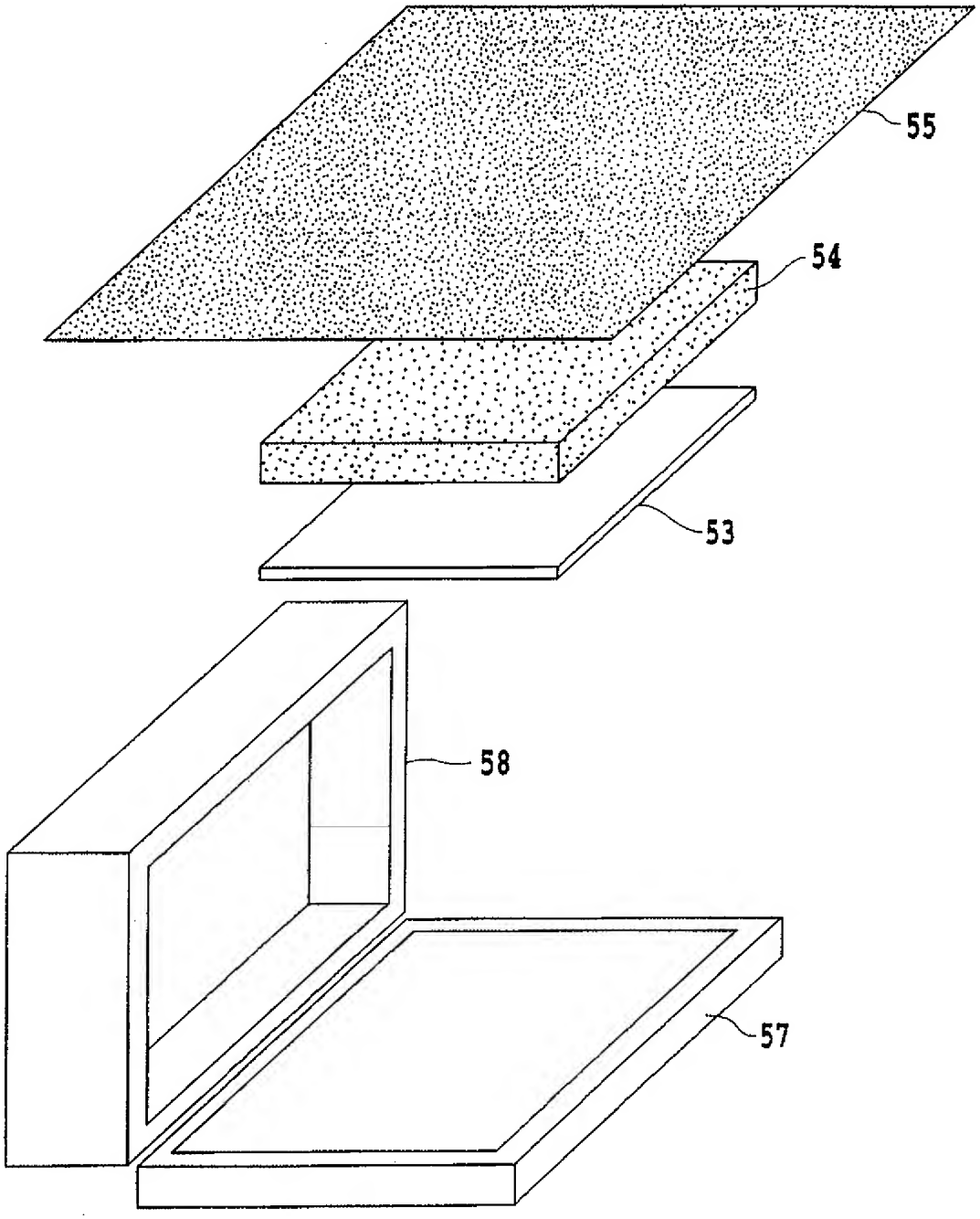
(c)



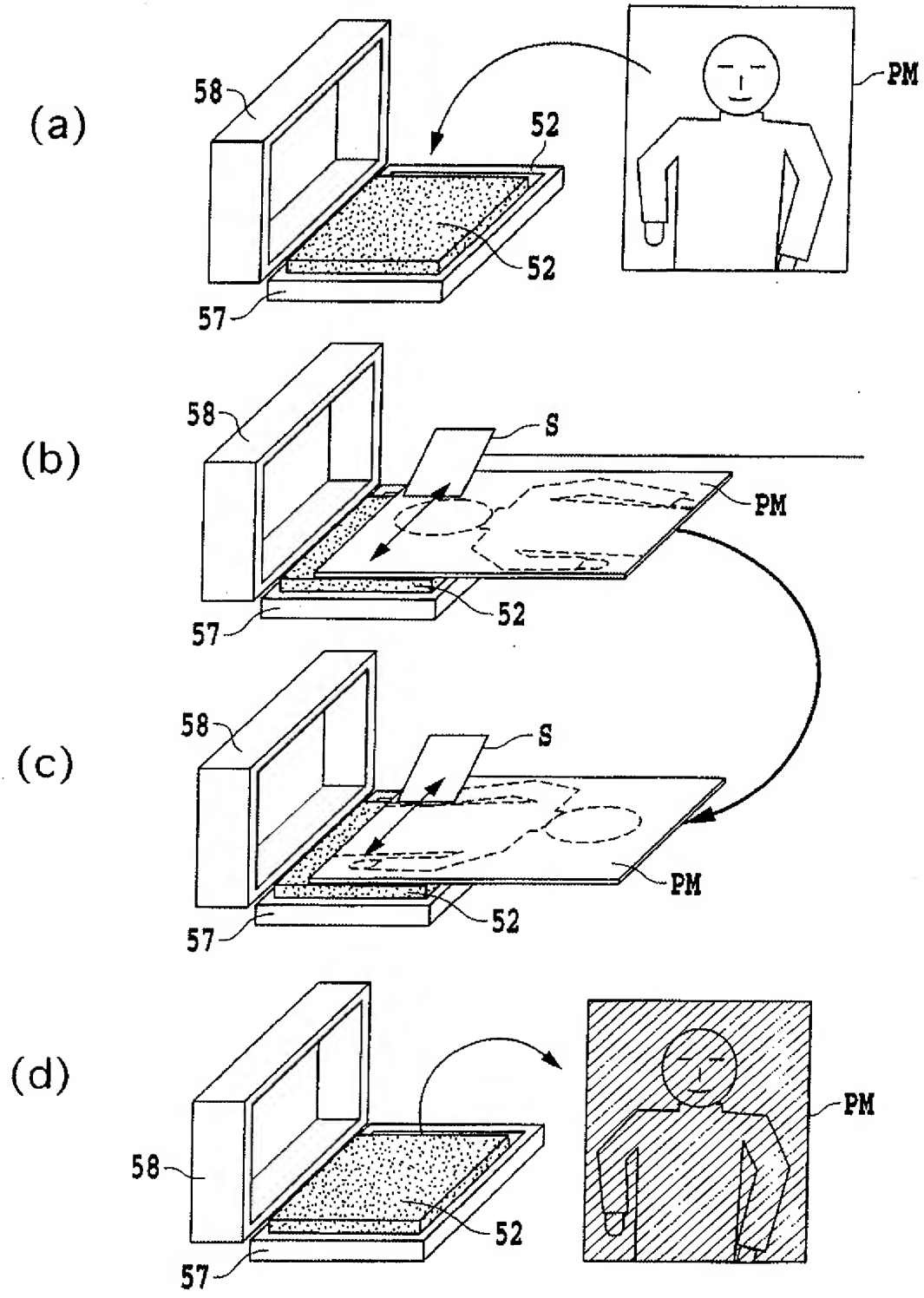
(Fig.15)



(Fig.16)



(Fig.17)



DOCUMENT NAME] ABSTRACT

[Abstract]

[Problem to Be Solved]

There are provided a liquid transfer device and a liquid transfer method which can enhance durability of an image with maintaining image texture of a raw image by transferring liquid to a printing medium on which an image is printed without laminating a protective member, such as glass, film or the like, on the image.

[Solving Means]

There is provided a liquid transfer device 2 for transferring liquid onto a printed surface of a printed product printed with ink. The liquid transfer device 2 includes a liquid accumulating portion 4 for accumulating the liquid; and a restricting portion which is formed from a porous film 5 formed with fine pores or the transfer surface per se and supplies the liquid in the liquid accumulating portion 4 to the transfer surface with restriction.

[Figure Selected]

Fig. 3